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Spectravideo and
Dragon 64 systems

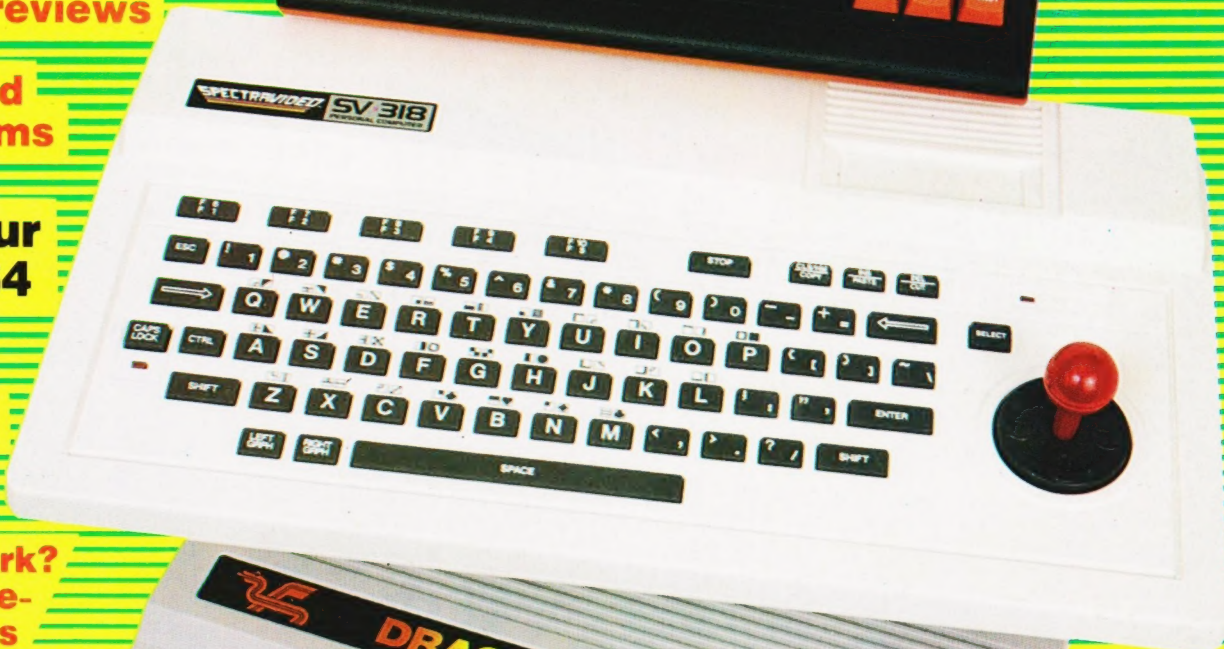
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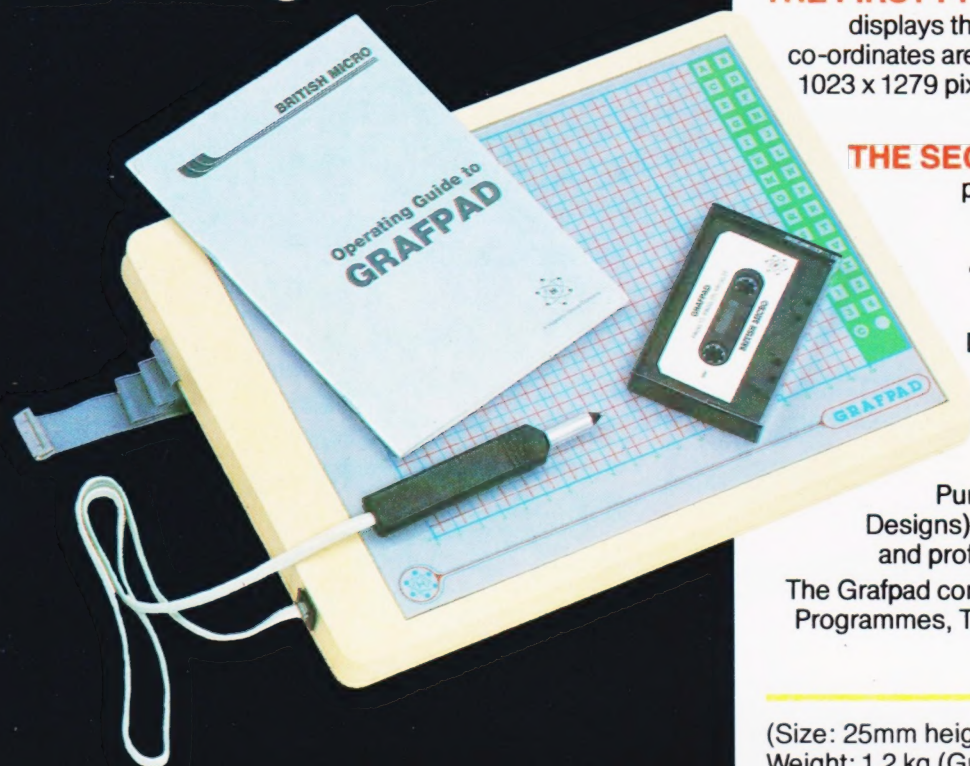
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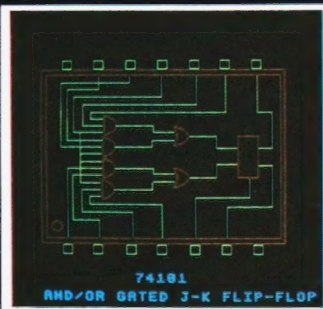
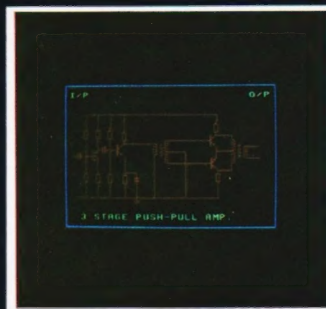
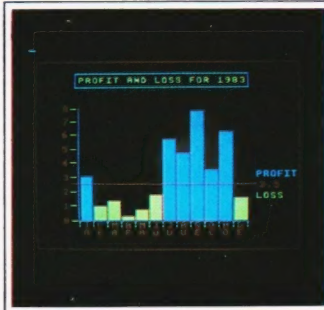
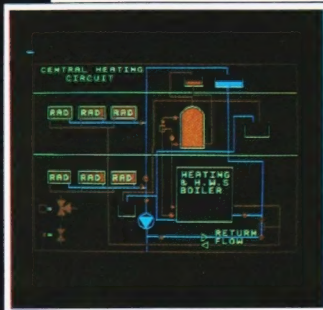
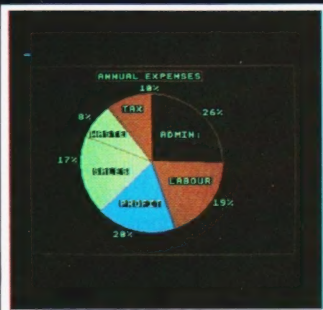
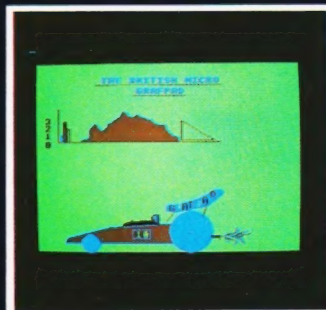
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CONTENTS

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Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards, please feel free to submit your work to us for consideration.

All material should be typed. Any programs submitted must be listed (cassette tapes and discs will not be accepted) and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

All work for consideration should be sent to the Editor at our Golden Square address.

NEWS..... 6

Our monthly round-up of the new products, both hardware and software, for computing at home and at your business.

EASYCODE PART 3..... 16

More typing this month, as we present the additional program lines to provide an assembler/disassembler.

DEBUGGING..... 25

Having problems with your programs? Whether it's your own fault or someone else's this article will help you fix it.

CHECK THE SPEC..... 33

First up on the test bench this month is the Spectravideo SV318, the first machine on these shores from the MSX stable.

DRAGON'S BREADTH..37

If you take a Dragon 32 and double it, do you get a machine twice as good? The Dragon 64 doesn't work quite that way, but add the magic ingredients discs and OS9 and things look up.

SOFTWARE CHART..... 43

Our new monthly guide to the software that's proving to be the most popular.

ELECTRONIC MAIL..... 45

Tired of the 'first-class' Post Office service? How about having a letter delivered in less time than it takes to walk to the nearest postbox? We look at computer communication.

READER SURVEY..... 49

Once again it's time to find out what the opinions are of the most important group of people in the world — our readers.

EXTENDING THE 64'S BASIC..... 54

If you're dissatisfied with the way Commodore have written their BASIC for the 64, we'll be showing how to tailor it to your needs in this major new series.

THE ATMOS STRIKES BACK..... 59

With a colourful new case and a decent keyboard, the Atmos seems to be an improvement over its ancestor, the Oric. But is it enough, and is it too late?

UPGRADING YOUR WP..... 63

The half-dozen machine code routines presented here will put a bit of life back into your Z80-based wordprocessor.

YOUR QUESTIONS ANSWERED..... 67

If you've got a question about your micro system, here's the place for an answer.

ADVENTURE WINNERS..... 68

Back before Christmas we ran a couple of competitions with an Adventure theme. Here are the answers and the lucky winners.

COMPUTERS AND THE COMMONS..... 72

The House of Commons is charged with the efficient running of the country's affairs, and ideally it would use the most advanced aids to do so. A pity life's not like that...

BOOK PAGE..... 80

Our reviewer shut himself away with an armful of books on the Commodore 64, and these are his findings.

GOING APE-FACE..... 84

A look at an oddly-named peripheral that lets you connect Atan computers to Centronics printers.

Z80 TEXT COMPACTOR..... 87

Just how can you get the huge novel you're writing into your memory, or program a really big adventure game? Like this.

WORD-WRAPPING..... 93

The PRINT function is pretty dumb on most BASICs — it will happily break words in two at the end of a screen line. This article is a bit smarter.

Personal Software.....	14
Next Month's Computing Today...	15
Subscriptions.....	58
Binders.....	65
Digital and Micro Electronics.....	66
Back numbers.....	76
Microdealer.....	90
Classified Ads.....	95
Computamart.....	97
Advertisers' Index.....	98

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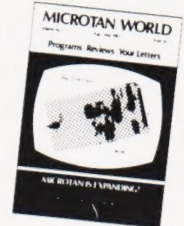
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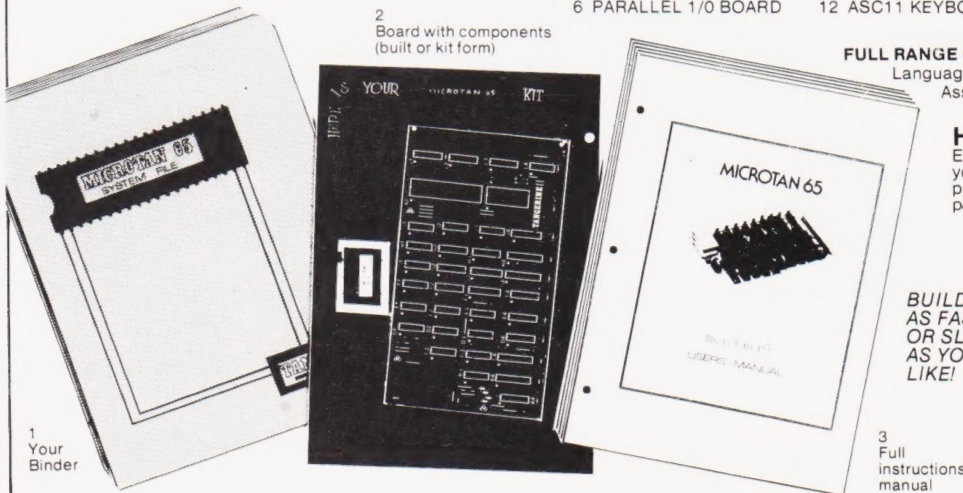
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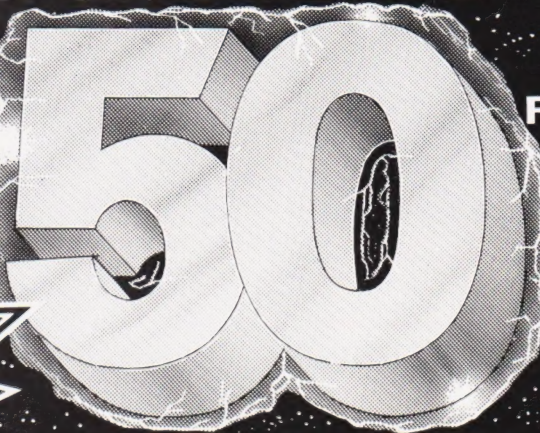
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REWIND	Rewinds tape to beginning
HALT	Halts tape between programs
SAVE (filename)	Saves a program to tape
LOAD (filename)	Loads program
SKIP (filename)	Skips to end of specific file
DIR	Displays directory of all files on tape
RUN (filename)	Loads and runs program
BREAK OFF	Disables the BREAK key
BREAK ON	Re-enables the BREAK key
FAST	Speeds up most DRAGONS
OLD	Recovers last program
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NEWS



COMPUTING TODAY MERGER

Astute readers will have noticed something a little different about our cover this month. There's a new logo under our name, and it means the start of a major improvement in your favourite micro magazine.

Beginning with this issue, the well-known news stand publication **MicroComputer Printout**, incorporating **Business Micro**, will itself be incorporated into **Computing Today**. That might make the full title a bit of a mouthful, but it also makes our magazine a bigger, better buy with a much

extended scope. **MicroComputer Printout** has always been one of the more literate of our competitors and we are delighted to be able to include its coverage of the business applications and social impact of computing.

However, we will not be neglecting our existing readers, people who want their home computer to be more than just a convenient arcade game. The merger of **Computing Today** and **MicroComputer Printout** will result in a magazine that is essential reading for the person who is serious about his computing, whether at work or at play. We like the direction this will take our magazine. We hope you will too.

SIMULATION SEMINAR

Professor Robert M. Howe of the Department of Aerospace Engineering at the University of Michigan is to be principal speaker at a three-day seminar on "Dynamic Accuracy of Digital Simulation". Sponsored by Applied Dynamics Inter-

national Limited, the seminar will be held at Castle Ashby House, Castle Ashby, Northamptonshire commencing Monday 30th April 1984.

Over the three days Professor Howe sets out to familiarise engineers and scientists with special techniques in real-time digital simulation, including integration algorithms, input/

MEMORIES...

MemoryText has been designed by Memory Computer to offer a comprehensive word processing package that has been specifically designed for non-technical personnel. Text and command functions are fully prompted. Not only does MemoryText contain all the

facilities that one would expect from a word processor, it also boasts the following additional features; for instance, bold face is displayed (in high intensity); underline is also displayed.

The program also provides for arithmetic calculations to be carried out within a page of text, and graphic functions are catered for. Word-wrap elim-



output extrapolation methods, transfer functions, and iterative techniques for solving implicit algebraic equations.

More importantly, he will present methods for quantitative analysis of dynamic errors resulting from numerical methods, so that the simulation engineer can choose the optimum method as well as predict ahead of time the computational speed required for successful real-time simulation of a given system.

Professor Howe is an acknowledged authority in the field of digital simulation, and has already presented a number of highly successful seminars in Europe. As Chairman of the University Aerospace Engineering Department he is engaged in teaching and research programmes on Real-time Digital Simulation, Automatic Control Theory, and flight simulation techniques. He was the first National Chairman of the International Simulation Council, a past member of the

US Airforce Scientific Advisory Board, and is now a consultant to numerous companies.

Robert Howe comments: "Real-time digital simulation of continuous dynamic systems plays an extremely important role of the development of complex technological systems, such as aircraft, missiles, space-craft, chemical process controls, robots, power plants and many others.

"It is also used in simulators for human operator training. As present and future technological systems become more complex and exhibit faster dynamic performance, the computer requirements in real-time simulation of such systems become more demanding. To meet such demands successfully not only requires faster computers but also requires skill and understanding on the part of the engineer who formulates the problem.

During the course of the seminar there will be a demonstration of the AD 10, a high

inates the need to enter a carriage return at the end of each line; a word too long to fit at the end of the line is automatically moved to the next line. File-merge enables you to take data from one file and combine it with another file containing text.

Memory are marketing MemoryText with the complete

range of Memory Systems. An attractively-priced word processing package that includes a Memory 8000 series computer and a daisy wheel printer is available for around £2500. For further details contact Ian McHarg Memory Computer Systems Ltd, Britannia House, 960, High Road, London N12 9RY (telephone 01-446 1441).

FLANNEL FROM ENTERPRISE

Enterprise Computers is the new trading name of the company formerly known as Elan, it was announced today (14th March). Enterprise has also revealed major new developments in the structuring of its launch programme and timetable for its 64K and 128K models. They include a multi-million pound manufacturing deal with a British electronics company, Welwyn Electronics.

With the new trading name of the company, the 64K and 128K models will continue to be known as "Enterprise". The name change reflects the company's international aspirations and its desire to establish a worldwide brand status. It follows an injunction forbidding the use of the Elan name in the UK.

The previous press leaks that Elan would change their to Flan-

were simply a load of flannel. It enabled the company to have some sort of identity during the six week gap between being forced to drop the name of Elan and tying up world rights to Enterprise, and in the words of Michael Shirley, director of marketing, "it injected a bit of humour into the situation."

The change involves retooling costs to Enterprise's equipment, instruction manuals, sales literature and club magazine. It has however, say the company, been well-received by major UK retailers contracted to sell the Enterprise models.

As a result of a tie-up with Welwyn electronics, Enterprise Computers will be manufactured in the UK. Enterprise and Welwyn have contracted to produce at least 150,000 units in the first year of production.

Welwyn Electronics is a subsidiary of the Crystalate Group and a sister company of Royal Worcester — the bone china manufacturers. The deal will create at least 90 jobs at the company's Tyneside factory in the first year of production. It is worth "over seven figures a month" in turnover to Welwyn which currently carries out component assemblies for blue-chip electronics companies.

Said technical director, Robert Madge of Intelligent

Software — inventors of Enterprise: "The Welwyn deal is a tremendous source of satisfaction to us. Quite apart from the superb standards of professionalism and expertise that Welwyn possess, it also gives the "British" tie-up we sought. The major UK retailers to whom we have been talking have stressed their desire for a British product in design and manufacture — the Enterprise is now exactly that".

While test models will be available in the spring, the Enterprise will be nationally available in the shops in September 1984. The 64K machine will retail at £199 plus VAT.

"We want to produce a trouble-free product and one that's available in enough numbers to supply initial demand," said Mike Shirley. "We've talked extensively with the retail trade in the UK and abroad, who would rather see a fully debugged model appear in September — in time for the Christmas rush."

The retooling exercise involved in the new Enterprise company name is of course partly responsible for the altered launch programme. But a further factor, says the company, is to provide time for careful testing and retesting of the revolutionary "Nick" and "Dave" chips.

speed digital computer specifically designed for the simulation of complex and highly non-linear dynamic systems. The AD 10 is manufactured by Applied Dynamics International of Ann Arbor, Michigan, USA and marketed in the UK by Applied Dynamics International Limited.

Professor Howe is also speaking at a similar seminar to be held at the Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland (7th-9th May 1984), which covers the same topics as mentioned above.

The cost per participant is £260 (£280 for the seminar in Switzerland) excluding VAT, travel, hotel and meals, but is inclusive of buffet lunches during the three days, refreshments and course material. Further details of both seminars can be obtained by contacting Applied Dynamics International Ltd, Oxford House, Oxford Street, Wellingborough, Northamptonshire (telephone 0933 72666).



NEW TAPE FROM ARGUS

In the early part of 1983, Argus Specialist Publications brought the world of computer publishing up-to-date with the launch of **Spectrum Computing**. This revolutionary concept of putting an entire computer magazine on tape was brought about by the need to communicate with computer owners in a form which could be easily understood. What better way to achieve this than to load each article into the computer and then be able to see actual examples and demonstrations running alongside the text?

Following the success of Spectrum Computing, Argus have launched three more titles to date. In chronological order these are: Model B Computing, VICTAPE Computing and Atari Computing. All these titles appear bi-monthly and are available from W. H. Smiths, John Menzies and all leading newsagents. They are priced at £3.99.

The latest addition to the range of on-screen computer titles is 64Tape Computing. The format of the magazine is balanced between games, utilities and tutorials. Full use is made of the 64's impressive sound and graphics throughout



the magazine, greatly increasing the impact of the editorial. Unlike many other magazines, 64Tape will appear to all owners, no matter what stage they have reached with their computers. Its content is designed to be informative, useful, but above all fun!

Among the contents of the first issue is a version of the ever-popular Frogger game, a complete adventure game, a multi-colour sprite editor and an assembler/disassembler. The magazine completely occupies both sides of a C30 cassette tape.

MINI-MO-DEM

Now, the advantages of being able to transfer data communications via the public telephone system have come within the reach of anyone who already has a computer of their own at home. Newbury-based Steebek Systems have just launched a home computer/business modem which will retail for under £100. Named the Minimo 300, the compact new unit is a 300 baud full duplex modem (to CCITT V21) which is switchable between answer and originate modes. The Steebek Systems Minimo 300 features a full specification RS232 interface, is BT approved and mains powered. It comes complete with integral telephone line cord and socket.

With so many schools and other educational institutions now owning computers, Steebek Systems have decided to make it easier for them to be able to afford their own modem too. The new Minimo will be available to any bona fide educational establishment at a special concessionary price. Full details can be obtained from Steebek Systems Limited, 3 The Paddock, Hambridge Road, Newbury, Berkshire RG145QT (phone 0635 33009; telex 849446 MODEMS G).



BITS AND PCBs FOR THE BEEB

The most powerful expansion of the Acorn BBC Microcomputer's capabilities to date has arrived. The new device, called the 6502 Second Processor, converts the standard BBC Micro Model B into a high speed dual processor system, outperforming all other home and per-

sonal computers currently available — including 16 bit and 32 bit machines.

The 6502 Second Processor makes possible many sophisticated applications — particularly those requiring complex graphics or fast handling — that hitherto would have been impracticable or impossible on a conventional low-cost Micro. The device is also

the first use of Acorn's patented Tube interface on the BBC Micro, a high speed data channel designed to enable external processors to talk directly to the BBC Micro's own processor.

With the 6502 Second Processor connected, the host BBC Micro is dedicated entirely to handling input and output, screen display memory and system filing. Meanwhile the second processor, with its own 64K of user memory and 3 MHz 6502 chip (double the memory and 50% faster than the BBC Micro itself) simultaneously concentrates on running the application program.

To enable users to get maximum benefit from their 6502 Second Processor, Acorn have developed a special 'Hi-BASIC' ROM Chip, which frees 44K of user memory for BASIC language applications. Up to 60K is available for assembly language programs. In addition, the full character set of the BBC Micro can be redefined without using any program memory.

A second ROM is provided to

update and replace the user's disk filing and/or Econet filing systems with a single combined chip. Both ROMs plug into the sideways ROM slots within the host BBC Micro.

The 6502 Second Processor also complements the BBC Micro in colour and size. It includes a ribbon connector to the host's 'Tube' port and an integral mains power supply with cable and plug.

The unit, complete with two ROMs and User Guide, costs £199 incl. VAT. It is available now direct from Vector Marketing Ltd., Dennington Estate, Wellingborough Northamptonshire NN8 2RL or from authorised Acorn dealers.

A new graphics tool for the BBC was launched at the same time. Called 'Acorn Bitstik', the new peripheral uses the increased power and speed of the 6502 Second-Processor-enhanced BBC Micro to provide a versatile, low cost computer-aided drawing facility comparable in quality and performance to many purpose-built systems.

HANG ON PHLOOPY

Phi-Mag Systems, a subsidiary of Phi Magnetronics of Falmouth, Cornwall, have this month introduced yet another non-standard data storage medium for microcomputers. But the PHLOOPY data storage system is a tape storage unit with a difference. Whereas existing alternatives to conventional tape storage media have been designed around $\frac{1}{8}$ " tape (as used in cassettes) and have utilised single-track recording heads allowing only serial data transmissions to take place, the PHLOOPY uses $\frac{1}{4}$ " tape and a nine-track recording head to allow records to be filed a byte at a time. These factors, coupled with the greater operational speed and reliability which the $\frac{1}{4}$ " tape permits, allow an unprecedented 100 KByte storage capacity (unformatted) from a single 12 foot, continuous loop, tape cartridge.

The drive unit itself is very unusual, in that it houses its own on-board microprocessor which, in addition to providing a complete error detection/correction facility, relieves the host microcomputer of time-

The Acorn Bitstik also demonstrates the long-term market strength of the BBC Micro, by both supporting the computer's existing roles — particularly in education — and extending its reach into new application areas. For schools and colleges, the professional designer and producer of schematics, plans or business charts, the Bitstik System offers a sophisticated graphics facility at an affordable price.

For comparative purposes, the cost of acquiring the entire system 'from scratch' — including Bitstik, BBC Micro, high resolution colour monitor, 6502 Second Processor, and Dual 800K Disc Drive, is under £2,000.

The Acorn Bitstik System, including joystick, ROM, utility discs and user guide, costs £375 including VAT, and is now available direct from Vector Marketing Ltd, Dennington Estate, Wellingborough, Northamptonshire NN8 2RL and from authorised Acorn dealers. We'll be reviewing one as soon as we can get our hands on it.

consuming housekeeping and file-handling operations, to the extent that a process such as formatting the tape can be performed with almost complete independence from the micro itself.

The system has been designed to be an alternative to the conventional disc drive and *not* a 'super' tape system. With data transfer rates in excess of 80,000 baud, which in practical terms means approximately 10 KBytes/second, this claim seems to be quite justified.

Although Phi-Mag may claim to have broken the '1K-per-Pound' barrier with their PHLOOPies (with each drive-unit costing £99) a complete kit consisting of one PHLOOPY drive, the PHLOOPY interface chips, the Loop Filing System ROM, manual and two PHLOOPY tape cartridges, will cost a little under £143. PHLOOPY cartridges are set to retail at £3.50, and Phi-Mag are currently lobbying software factors in an effort to establish PHLOOPies as a medium for ready-made software.

Although the PHLOOPY system is currently only available for use with the BBC micro, it is expected that versions for other micros will be available shortly. Don't go looking for it in your local computer store, though — Phi-Mag are making the system available by mail-order only, at least for the time being! For further information, interested parties should contact Phi-Mag Systems Ltd, Tregonigge Industrial Estate, Falmouth, Cornwall TR11 4RY.



OOPS, OOPS AND OOPS AGAIN!

A trio of bugs to report on this month, to our shame. The first involves the diagram in last month's Learning FORTH Part 6. It was the wrong figure, and turns up this month in its rightful place in the Commodore BASIC article. There have been a few other problems throughout the series (such as the Mysterious Disappearing Camera-ready Artwork of Part 5!) and next month we'll publish an update feature to sort out all these problems. For those who can't wait, however, the elusive Fig. 1 is reproduced here. Honest.

Next we come to the BBC Poker program. The listing in the March issue contained two 'undocumented features' — sounds better than bugs. The first of these made it impossible to access the instructions for the program, and can be cured by changing line 260 to:

260 IF A1\$="Y" PROC-
INSTRUCTIONS

The second, and more serious error occurs within the pro-

cedure for offering a loan to the player if his or her kitty falls below zero. The procedure, rather than halting the program and asking the player whether he/she wants the loan, simply gives the player the loan and rampages ahead with the rest of the game. To cure this, look at the line between 2520 and 2540. It should, of course, be numbered 2530, not 2350, and it should actually read:

2530 Z2\$=GET\$
The reason for the latter error is a trifle embarrassing, and it suffices to say that the editor is typing this apology with his elbows. Our thanks to Mr. J. Jacques of Berkhamstead for bringing this bug to our attention.

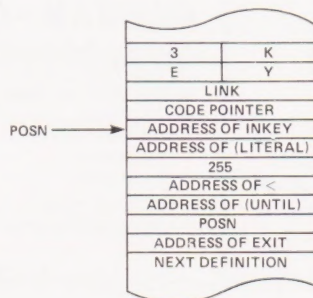
Finally we turn to the Genie Commands article from last month (April), which needs one or two corrections. For the program to work correctly with Level III BASIC resident, four modifications have to be made to the listing. Line 05550 becomes:

05550 AMD1 JP Z,ERROR
and line 06250 becomes:

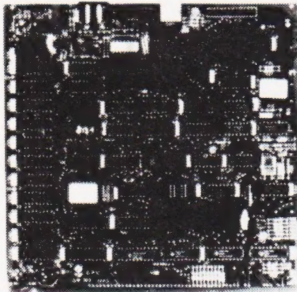
06250 LD B,95

Two new lines need to be inserted into the program:
07435 DEFW ERROR-6000H
08375 DEFW AMD1+1

In Fig. 2 on page 51, there should be two asterisks between the 16 and the P, ie (A*16**P). Below Fig. 6 on page 55, there is a missing) just before the , expression 2. Finally, on page 59 in the main text, second column, the Find Label routine actually starts at line 3410 and not 3140 as stated. Sorry!



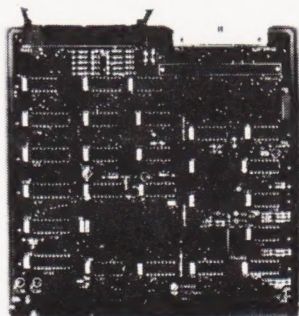
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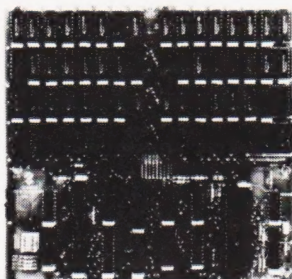
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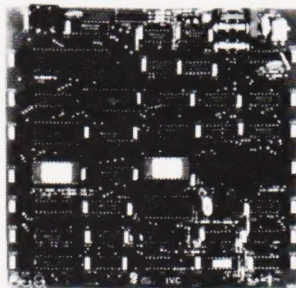


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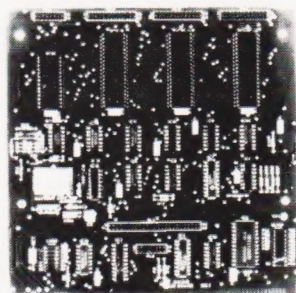
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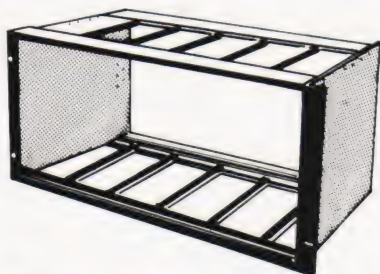
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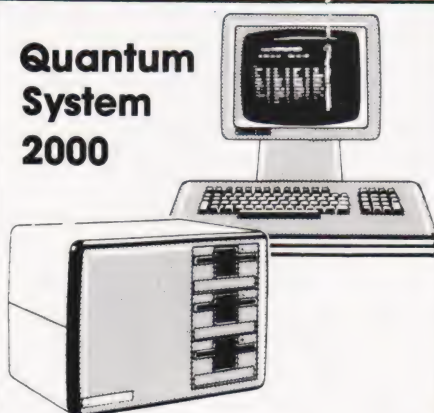
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The Gemini Multinet enables as many people as possible to have access to their own microcomputer with mass storage and printer facilities for the lowest possible cost. This is achieved by providing a central 'filesaver' fitted with a Winchester hard disk unit and printer interfaces, in conjunction with a method of interconnecting up to thirty-one workstations to the filesaver. The filesaver and each station are fitted with the Gemini GM836 network interface board. A Micropolis 800K floppy disk drive is incorporated in the filesaver providing backup for the hard disk.

GM910 Galaxy 4 Multinet 5.4 M/byte filesaver **£2600**

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Both fileservers and workstations are supplied complete with VDU's; the operating software is supplied with the filesaver.

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ACCOUNTING WITH MICROFACTS

Two new modules for the Microfacts integrated accounting system have been introduced by Facts Software Limited, on one of the UK's leading independent micro computer software houses. The new modules are Job Costing and a Nominal Report Generator, which — with Microfacts existing modules — makes the package one of the most comprehensive and cost-effective accounting systems available in the UK.

"Both these new modules are clear, concise and to the point," says Geoff Taylor, Facts' managing director. "They incorporate well-designed displays and reports, presenting all the information required in a user-friendly manner."

The Job Costing module allows users to record costs incurred on a project with up to 30 cost headings, including budgets, to give variance and pro-

fitability analyses. Quantities can also be accumulated per cost type per job, and can be recorded in either units of time or units of materials; the module also allows for the input of time sheets. Job Costing can be run stand-alone, or linked to Purchase Ledger, Sales Ledger and Sales Invoicing, in any combination.

The Report Generator module allows the production of user-specified reports from the Nominal Ledger. It has the ability to produce ratios between figures on the reports, and to take percentage apportionments.

These two modules, and the addition of a Payroll module in the near future, will enable Facts to reach a much wider market, according to Geoff Taylor.

Microfacts is an extremely flexible and practical accounting system, available on the IBM XT, Victor 9000, ACT Sirius, Commodore 700 and

8000, and the DEC Rainbow. It was also released on the ACT Apricot at the Apricot and Sirius Show in early February. Designed by accountants rather than programmers, it offers many additional facilities at a similar price to most accounts packages.

There are many unique features in the system, including the ability, when posting cash, to specify which bank account is updated — with competitive systems, cheques can only be posted to a single account; a 'nudge' facility allows the operator to obtain an account record without knowing the full account code; the incorporation of password protection down to program level allows only certain users access to confidential information, and the ability to print messages on the bottom of statements and sales invoices as they are produced.

In addition, the system is able to 'work ahead', for example,

sending out next month's invoices before the previous month's accounts are up to date; something no other accounts system allows.

For further information, contact Facts Software Limited, Ketwell House, 75-79 Tavistock Street, Bedford MK40 2RR (telephone 0234 218191).

IT'S HOBBIT-FORMING

You've played the game, now read the book. In response to overwhelming demand from computer adventure game fans, Melbourne House are publishing a new book **A Guide To Playing The Hobbit**. Thousands of Hobbit fans regard the game as the most exciting and challenging adventure available for the Spectrum 48K, Commodore 64, Oric and BBC B machines. Now with this book as a guide anyone from a beginner to an advanced adventurer will be able to

ALL GO FOR LOGO

Atari International (UK) Inc has introduced a powerful new version of the high level computer programming language, Logo, for use in schools and homes. Atari Logo provides a friendly introduction to programming for beginners, as well as being a serious tool for advanced programmers. With Atari Logo users can create programs that converse in recognisable words and sentences, such that beginners can manipulate text and shapes on the TV screen the very first time they use Atari Logo.

By experimenting with Atari Logo, students of all ages can discover the principles of computer programming, geometry, maths and physics. Collision, animation and four dynamic graphics turtles, not usually found in other versions of Logo, allow users to create video game-quality animated graphics. Other unique features of Atari Logo include 128 colours available simultaneously on one screen and multi-voice sound capabilities. Joysticks can add a playful dimension to Atari Logo programming.

The Atari Logo program cartridge works on all Atari home computers and requires as little as 16K RAM. The complete package, including a handy

reference guide and two 200-page manuals — **Introduction to Programming Through Turtle Graphics** and **Atari Logo Reference Manual** — sells for the suggested retail price of £59.99 (including VAT).

Meanwhile, Kuma Computers have launched a new, fast, user-friendly version of Logo on the Sinclair Spectrum. Logo Graphics is a tool for practical exploratory geometry, providing experience of angles, lengths, directions, radii and colour. The user can discover the structure of geometric shapes, experiment with patterns and gain invaluable experience in the estimation of quantities such as distance and angles.

In addition to using the pre-defined procedures contained in Kuma Logo, users can define new procedures of their own, saving them to tape for future use. A calculator is incorporated into the interpreter to allow the user to be independent from other calculating aids.

Kuma Logo comes complete with a user manual and is available from good micro stores or direct from Kuma Computers at £9.95 including VAT. For further details of this and other Spectrum software contact Kuma Computers Ltd, 12 Horseshoe Park, Pangbourne, RG8 7JW (phone 07357 4335).



improve their understanding of this complex game, winner of the Golden Joystick Award for "Strategy Game of The Year" for 1983.

A Guide To Playing The Hobbit is divided into three sections. Section one gives the reader broad outlines as to the general strategies and tactics involved in playing the game, while sections two and three give an increasing amount of guidance offering more detailed solutions to problems the player may encounter.

While providing solutions to the problems encountered in *The Hobbit*, the beauty of the book is that it does not spoil the fun and challenge of the adventure. It does not supply THE solution to *The Hobbit* — it only offers one of many possibilities. So even the keenest adventure fan will have to admit it is an essential aid to anyone who owns the game.

A Guide To Playing The Hobbit is published by Melbourne House, who created the original *Hobbit* game. Written by David Elkan it retails at only £3.95 and will be available in bookshops from April.



EPSON BUILDING ON SUCCESS

Now on permanent display at the Building Computer Centre on London's Store Street off Tottenham Court Road is a full range of computer products from Epson (UK) Limited which have been specifically developed to meet the needs of the British construction industry.

A fully operational workstation will allow demonstration by trained experts of a series of software packages designed for use on the Epson QX-10 desk top microcomputer and the company's award-winning portable micro, the HX-20. These packages span the areas of two dimensional drawing, project management, quantity surveying, land surveying and special accounting packages. A range of Epson printer products will also be on display.

The Epson HX-20 will prove invaluable for on-site use in the construction industry. It is a fully-functional computer with its own printer, liquid crystal display and full size keyboard, all contained within the size of an

A4 notepad. Weighing only two kgs, and with a standard 16K RAM memory, it operates on its own battery supply for 50 hours without recharging and has the ability to retain its memory in RAM even when switched off. It can communicate with virtually any other computer in use either directly or across telephone lines.

The Epson QX-10 is a fully integrated desk top system with a modern functional design including dual disc drives and a full size qwerty keyboard. It is particularly easy to use for the first time operator and has 192K RAM, upgradable to 256K RAM. Special features include a 16:1 zoom, a variety of type-stYLES, split screen facility and excellent graphics capabilities due to the high screen resolution.

Of particular interest to draftsmen is a computer integrated drafting system developed for the QX-10 by Graphics Avant-Garde of Warrington, Cheshire. The system repackages the QX-10 as a drawing board replacement capable of making any draftsman up to four times more effi-

cient and thanks to the special features of the QX-10 the program runs very quickly — faster than the majority of comparable, but higher priced systems. In its most basic form, this CAD system costs £3,500 for the hardware, software and an Epson RX-80 printer for producing hard copy.

Also designed for use on the QX-10 is Pertmaster, a tried and tested software package for project management. Invaluable for the organisation of multi-discipline building and civil engineering projects, Pertmaster can analyse and evaluate an entire network of inter-related activities in under 30 seconds. This speed of operation ensures better control over time and deadlines, makes it easy to check, and modify if necessary, critical path activities; allows the best possible use of available resources and allows you to simply ask the computer 'What if?' or 'What next?'. Printouts include an overall project bar chart, a period bar chart, histograms of resource demand plus standard and selective reports. The software, which has been

PLUGGING ERRORS

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The labels are vinyl and can be wiped, and yet, although they are tenacious once applied, they can be removed and re-applied if desired. They are designed to be easily read and understood, and they add an attractive, organized detail to any home. Available soon in many different outlets throughout Britain, including DIY stores, newsagents and stationers and electrical shops, the pack of 80 labels retails at an RRP of 70p a packet. Alternatively an SAE, together with a 70p postal order made out to Rite-plug Ltd, can be sent to the address below. For further information regarding Rite-plug labels contact Neil Cowell, Marketing Director, Rite-plug Labels Ltd, 24 The Mall, Clifton, Bristol BS8 4DS.

developed by Abtex Computer Systems Ltd of Aberdeen, is designed for self-teaching and costs £650 including all documentation.

Ideal for use on building sites or on location, where instant communication and transfer of vital information is required, is DIALTEXT, a remote printing system developed by Talbot Computers Limited of Bournemouth. Using the HX-20 and an acoustic coupler, Dialtext allows users to transfer and receive information across the telephone line to and from another computer. The installation at the Building Computer Centre will consist initially of the Dialtext receive only station using the HX-20 and through the use of an auto-answer modem it will give an instant hard-copy printout from almost anywhere in the world, 24 hours a day.



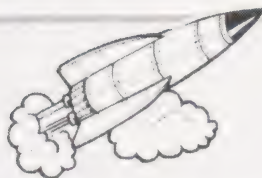
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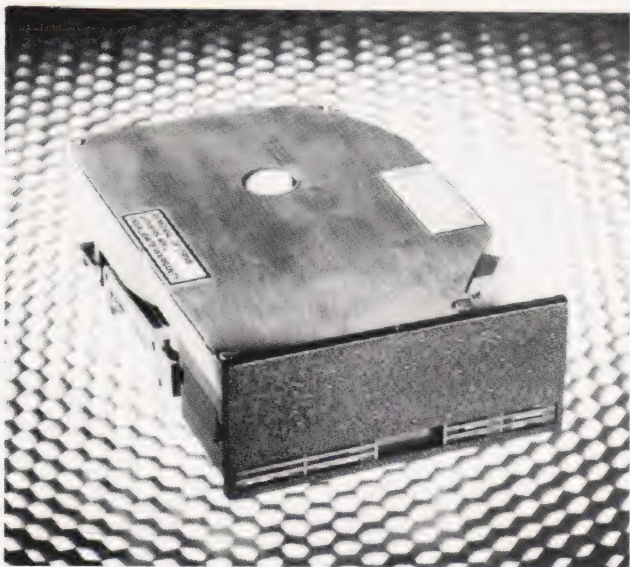
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SEEING THROUGH THE BEEB

Imbuing the microcomputer with the equivalent of the human senses is not that easy. Why do you think robots are so expensive? However, the video boom has resulted in cheaper cameras and it's inevitable that companies will start to interface them to home micros with the object of providing sight. One such system is the Microeye from Digithurst Ltd, which has made brief appearances in our news pages. Next month it makes its way to the front page of Computing Today, where we'll have colour examples of the effects you can produce on the BBC Micro in Mode 2. Read our review in the June issue.



HARD FACTS ABOUT HARD DISCS

Hard discs, or Winchester, have some nice properties. They are fast. They hold a lot of information. They are also pretty expensive, but prices are coming down and even that well-known cost-cutter Sir Clive Sinclair expects they will be used with his QL computer (whenever it finally appears). Find out the message about the medium in Computing Today next month.

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

A FEAST OF FANTASY

Starting next month we'll be having regular Adventure reviews, and we get off to a great start with games for the BBC Micro, the Commodore 64, Atari, Spectrum and Dragon 32. Among the games mentioned will be BBC programs from the masters of text compaction, Level 9, and Dan Diamond will be trying to find his way out of the Dragon. If you're puzzled now, you'll be totally flummoxed by the June issue of Computing Today.

CP/M DIRECTORY

CP/M, for all its faults, sports one of the largest ranges of software of any operating system. New software continues to appear for it even now, and starting next month we'll be guiding you through the jungle by publishing a CP/M Software Directory. Find the application you need with the June Computing Today.

MICROWRITING

Are you a two-fingered typist? Instead of trying to learn the QWERTY keyboard on your BBC Micro so that you can use all 10, why not settle for five fingers? Why not try the Microwriter? This one-handed input device, cut down from the original hand-held word processing system, plugs into your BBC and, once the simple mnemonics for the key-press sequences have been learnt, fast text entry is possible. Why, even the editor managed to pick it up quite quickly!

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EASYCODE PART 3

Simon N. Goodwin

In this article of our Easycode series we let you talk to your computer in English (almost!) and show you how to have stacks of fun.

This month we'll add a number of extra features to the Easycode language. The new features make Easycode even more like 'real' machine-code — in fact the only major difference left will be the lack of binary operations, which we will explain next month.

The new program lines also give you a small 'assembler' and 'disassembler', via the added commands 'ASM' and 'DIS'. These facilities are not as versatile as the real thing, but they're still useful. They're also easy to use 'interactively' — you can chop and change your program clearly and fast.

The lines in Listing 1 are not a complete program — they are EXTRA lines to be added to those published in the March 1984 CT. This means that we can print a program which is longer than we could otherwise, but it isn't very helpful for intermittent readers! Back issues can be obtained using the coupon on Page 76.

CONVERTING THE PROGRAM

The extra lines restrict the range of computers on which the program can run, since they require a few extra features. String arrays are needed to run the assembler and disassembler. The stack display requires a screen 40 columns wide, although it could be programmed horizontally if more than 16 lines are available. The listing is for the TRS-80 Model 1 or Video Genie. The complete program requires 16K of BASIC memory.

Most of the program is fairly easy to convert, bearing in mind those restrictions and the notes published last month. You may need to alter the DIM statements on line 1030 to dimension each variable separately and to tell the computer how long each string may be (eg DIM D\$(MAX,10)).

Microsoft BASIC string handling is used, as on Apple, Commodore and recent Acorn machines. Line 18520 compares

Listing 1. Extra program lines to provide Easycode with an assembler, a disassembler and stack operations.

```
100 REM ** EASYCODE Big version.
110 REM ** (C) 1984 Simon Goodwin
1020 MAX=25 ' Highest instruction code
1030 DIM D$(MAX),E(MAX),S(9)
1040 GOSUB 6500
6490 REM ** Set up data for Asm. & Dism.
6500 FOR I=0 TO 25
6510 READ D$(I),E(I) ' Text & instruction No.
6520 NEXT I
6530 RETURN
6990 REM ** Push N onto stack
7000 COLUMN=36
7010 ROW=10-STACK
7020 IF ROW=0 THEN 7110
7030 S(STACK)=N
7040 GOSUB 8000
7050 STACK=STACK+1
7060 COLUMN=37
7070 ROW=12
7080 N=STACK
7090 GOSUB 8000 ' Update S display
7100 RETURN
7110 COLUMN=1
7120 ROW=15
7130 GOSUB 6000 ' Prepare for message
7140 PRINT"Stack full";
7150 GOTO 11580 ' Leaves 1 GOSUB stacked
7490 REM ** POP N from top of stack
7500 STACK=STACK-1
7510 IF STACK<0 THEN 7580 ' Whoops, error
7520 GOSUB 7060
7530 COLUMN=36
7540 ROW=10-STACK
7550 GOSUB 6000 ' Prepare to clear old entry
7560 PRINT" "; ' <2 SPC>
7565 N=S(STACK)
7570 RETURN
7580 PRINT"Nothing left on stack";
7590 GOTO 11580
9330 PRINT"EASYCODE (C) 1984 Simon Goodwin.";
9340 COLUMN=33
9350 FOR ROW=1 TO 10
9360 GOSUB 6000 ' Position cursor
9370 PRINT" "; ' 6 spaces
9380 NEXT ROW
9390 ROW=11
9400 GOSUB 6000
9410 PRINT"-----";
9420 ROW=12
9430 GOSUB 6000
9440 PRINT". (S=00)";
9450 ROW=13
9460 GOSUB 6000
9470 PRINT"-----";
9480 RETURN
10140 IF T$="DIS" THEN 17000
10150 IF T$="ASM" THEN 18000
11080 COLUMN=36 ' Clear stack
11090 FOR ROW=1 TO 10
11100 GOSUB 6000 ' Position cursor
11110 PRINT" "; ' <2 SPC>
11120 NEXT ROW
11130 STACK=0
11140 N=STACK
11150 COLUMN=37
11160 ROW=12
11170 GOSUB 8000 ' Rewrite stack pointer
11180 K=0
11190 GOTO 5000 ' Write A,X etc.
11665 IF I=21 OR I=23 THEN K=1
11690 ON I-19 GOTO 21300,21300,21400,21400,21500,21600
14100 PRINT"DIS to disassemble memory"
14110 PRINT"ASM to assemble into memory"
16990 REM ** Disassembler - main loop
17000 ROW=14
17010 COLUMN=1
17020 GOSUB 4000 ' Clear prompt line
17030 PRINT "Disassemble from";
17040 GOSUB 4500 ' Get number
17050 IF N>99 THEN 10000 ' Whoops
17060 CLS ' Clear screen
17070 PRINT"Addr..Value....Disassembly";
17100 FOR P=2 TO 14
17110 GOSUB 17500 ' Disassemble 1 line
17120 NEXT P
17130 PRINT
17140 PRINT"Continue disassembly (Y/N)";
17150 INPUT T$
17160 IF T$<>"Y" THEN 17190
17170 N=N-2 ' Ensure overlap
17180 GOTO 17060
17190 GOSUB 9000 ' Re-draw screen
17200 GOTO 10000 ' Back to command
17490 REM ** Disassemble the code at N
17500 IF N>99 THEN RETURN ' End of memory
17510 K=M(N) ' Get 1 char.
17520 COLUMN=1
17530 ROW=P
17540 GOSUB 6000 ' Address field
17550 PRINT N;
17560 COLUMN=7
17570 GOSUB 6000 ' Value field
17580 PRINT K;
17585 J=100
17590 FOR I=0 TO 25
17600 IF K<>ABS(E(I)) THEN 17630
17610 J=1 ' Get instruction text No.
17620 I=100 ' Flag end of loop
17630 NEXT I
17640 IF J>25 THEN 17790
17650 IF E(J)<0 THEN 17710 ' 2 char. instruction
17660 COLUMN=16
17670 GOSUB 6000 ' Instruction field
17680 PRINT D$(J);
17690 N=N+1 ' Select next address
17700 RETURN
17710 N=N+1
17720 IF N>99 THEN 17790
17730 K=M(N)
17735 PRINT K;
17740 COLUMN=16
17750 GOSUB 6000 ' Instruction field
17760 PRINT D$(J);
17770 PRINT K;
17780 GOTO 17690
17790 COLUMN=16
17800 GOSUB 6000 ' Instruction field
```

D\$(I) with the leftmost characters of T\$ (making sure that the number of characters is the same in each). If your BASIC uses fixed-length strings you will need to take trailing spaces into account. The other tricky line is 18535, which sets T1\$ to contain all the characters in T\$ after position 'I'.

The '+' operator is used to stick strings together, so that PRINT "Easy"+"code" gives:

Easycode

This will work on most computers other than Ataris, where devious use of string-slicing will be needed. String '+' is only used in Easycode to make error messages, so it should be possible to make the program work without the feature — so long as you find another way of reporting problems.

The DATA in lines 30000 onwards is copied into the arrays DS() and E(). If your computer won't allow READ and DATA statements, you must use 52 assignments instead (my sympathies).

Listing 1 has been automatically mixed back into the original program. The combination worked at once, so the listings should be compatible unless our layout department have scalpel problems! If you type in the lines and they won't work, please check that you've made compatible changes in both parts of the listing, and you haven't mistyped any line-numbers.

USING THE ASSEMBLER

The assembler converts mnemonics like 'LOAD' and 'HALT' into the numbers recognised by the computer. You type in relatively-readable lines such as 'ADD A;7' and the routine generates the

values '5' and '7'. The numbers are put into memory (you can see them appear, just as with the 'STORE' command) and you can type another line.

The main difference between the ASM facility and the assembler of a real computer is the lack of 'names' for locations and values. A real assembler would allow you to give a location a name, such as 'TOTAL', and then refer to it by name: STORE A:@TOTAL. This feature is missing from ASM as it would make the routine slower, less portable and harder to use (you'd have to check for names used before they were identified, for instance). Since Easycode only uses 100 memory locations that lack of naming is not a major drawback.

To use the assembler, type ASM in response to the Command prompt. You will be asked where you want to store code, just as with the STORE command. Enter a sensible address or '100', if you want to chicken out. As you type the mnemonic lines, one by one, the computer stores the appropriate codes. To leave the assembler type '100' instead of a mnemonic.

There are four possible error messages when you use the assembler. 'Unknown' appears if the computer can't recognise the mnemonic from its list of 26 possibilities. If you entered ADD B;1 you'd get the message, since there is no 'B' register. You'd also get it if you typed TWIDDLE THUMBS as there's no Easycode instruction to do that. The only special word you can use is HELP, which prints a list of the mnemonics allowed. If you have trouble, use the HELP command to see the format required — in particular, avoid using extra spaces.

The message 'Too long' appears if the computer understands

```

17810 PRINT "Data code: ";K;
17820 GOTO 17690 ' Exit
17990 REM ** ASSEMBLE - main loop
18000 ROW=14
18010 COLUMN=1
18020 GOSUB 4000 ' Cursor for prompt
18030 PRINT "Assemble to:";
18040 GOSUB 4500 ' Get address
18050 IF N>99 THEN 10000 ' Error
18060 K=N ' Save start address
18070 ROW=15
18080 GOSUB 4000 ' Cursor on message line
18090 PRINT "Assembling. Type 100 to stop:";
18100 ROW=14
18105 GOSUB 4000
18110 PRINT K;"=";
18120 INPUT T$
18130 IF T$="HELP" THEN 19000
18140 IF T$="100" THEN 18180
18150 GOSUB 18500 ' Assemble one line
18160 COLUMN=1 ' Just in case
18170 IF K<100 THEN 18070 ' Re-prompt
18180 ROW=14
18190 GOSUB 4000
18200 ROW=15
18210 GOSUB 4000
18220 IF K>99 THEN PRINT "* End of memory reached";
18230 GOTO 10000 ' Get new command
18490 REM ** Assemble one line into M(K) from T$
18500 J=100
18510 FOR I=0 TO 25
18520 IF D$(I)<>LEFT$(T$,LEN(D$(I))) THEN 18550
18525 J=E(I) ' Get instruction code
18530 I=LEN(D$(I)) ' Get length of instruction
18535 T1$=MID$(T$,I+1,LEN(T$)-I) ' Get remainder
18540 I=100 ' Flag end of loop
18550 NEXT I
18560 IF J<0 THEN 18740 ' 2 char. instruction
18570 IF J<26 THEN 18660 ' 1 char. instruction
18580 T$="* Unknown:"+T$
18590 ROW=15
18600 GOSUB 4000 ' Clear old message
18610 PRINT T$;
18620 FOR I=0 TO 1500
18630 NEXT I
18640 GOSUB 4000 ' Clear message
18650 RETURN ' Error exit
18660 IF T1$="" THEN 18690 ' No trailing junk
18670 T$="* Too long:"+T$
18680 GOTO 18590 ' Print message & return
18690 N=J
18700 I=K
18710 GOSUB 16500 ' Update display
18720 K=K+1 ' 1 more location used
18730 RETURN ' Success return
18740 IF K<99 THEN 18770
18750 T$="* Only 1 memory space left"
18760 GOTO 18590 ' Print message
18770 IF T1$<"0" OR T1$>"99" THEN 18840
18780 I=VAL(T1$) ' Check range 0-99
18790 IF I>99 THEN 18840
18800 N=ABS(J) ' Get instruction-code
18810 GOSUB 18700 ' Store N
18820 N=VAL(T1$)
18830 GOTO 18700 ' Store parameter & return
18840 T$="* Incorrect number:"+T1$
18850 GOTO 18590 ' report error
18990 REM ** HELP for Assembler user
19000 CLS ' Clear screen
19010 PRINT "Valid instructions:";
19020 FOR I=0 TO 12
19030 ROW=I+2
19040 COLUMN=1
19050 GOSUB 6000
19060 PRINT D$(I);
19070 IF E(I)<0 THEN PRINT "nn";
19080 COLUMN=16
19090 GOSUB 6000
19100 PRINT D$(I+13);
19110 IF E(I+13)<0 THEN PRINT "nn";
19120 NEXT I
19125 PRINT
19130 PRINT "'nn' is a number from 0 to 99"
19140 PRINT "Please press <CR> when ready";
19150 INPUT T$
19160 GOSUB 9000 ' Re-draw screen
19170 COLUMN=1
19180 GOTO 18070
21290 REM ** PUSH Register
21300 N=R(K)
21310 GOSUB 7000 ' Put N on stack
21320 P=P-1
21330 GOTO 11500
21390 REM ** POP register
21400 GOSUB 7500 ' Get N from stack
21410 R(K)=N
21420 P=P-1
21430 GOTO 5000
21490 REM ** CALL;address
21500 N=P ' Save current program counter
21510 GOSUB 7000 ' Push address
21520 P=J ' Start processing there
21530 GOTO 11500
21590 REM ** RETURN
21600 GOSUB 7500 ' Get return address
21610 P=N ' Start processing there
21620 GOTO 11500
29990 REM ** Assembler text & codes
30000 DATA STORE A;2X,18,LOAD A;2X,17
30010 DATA STORE A;2,-3,STORE X;2,-13
30020 DATA LOAD A;2,-2,LOAD X;4,4
30030 DATA SUB A;2X,7,LOAD X;2,-12
30040 DATA LOAD X;A,14,ADD A;2X,19,JUMPNZ;,-9
30050 DATA JUMPNZ;,-8,LOAD A;,-1,LOAD X;,-11
30060 DATA PUSH A,20,PUSH X,21,RETURN,25
30070 DATA ADD A;,-5,ADD X;,-15,SUB A;,-6
30080 DATA SUB X;,-16,JUMP;,-10,POP A,22
30090 DATA POP X,23,CALL;,-24,HALT,0

```

the first part of an instruction but didn't expect the rest. Trailing spaces or words may cause that message. If you try to use a name instead of a number, or type a silly value, the computer comments 'Incorrect number'. Nothing is stored if you make a mistake. You are asked to type the line again.

There is one obscure error message. If you try to store an instruction which needs two locations at address 99, the computer displays 'Only one memory space left'.

THE DISASSEMBLER

The disassembler converts numbers back into mnemonics — the opposite of the assembler. Type the command DIS and then tell the computer where in memory you wish the disassembly to begin. Each location will be examined and the appropriate mnemonic printed. If the location contains a value which does not correspond to an instruction the value is assumed to be data, and the mnemonic 'Data code' appears.

The disassembler prints the value and name of each instruction. Each disassembly consists of 13 lines, after which you can opt to stop or continue. If you continue there is a deliberate small overlap of addresses. Experiment with the disassembler to see how it works. Try disassembling data as well as programs, and see what happens if you start the disassembly in the middle of a program or instruction. This shows how the computer can produce strange results if programs are RUN from odd places.

SAME OLD PROBLEMS

Last month we set a couple of problems for keen programmers. Listing 2 shows a solution to the second, and simpler, problem — counting the number of occurrences of a given value in memory. Hopefully you didn't have much trouble solving this. The comments at the side of the listing should make it fairly easy to understand, especially as it is quite similar to the 'adder' program published last issue.

You might like to try out the assembler by entering the mnemonics of Listing 2. Disassemble it to make sure you've made

0:	1	0	LOAD A;0	Count so far is zero
2:	3	99	STORE A;99	Store total
4:	11	0	LOAD X;0	X is start of search
6:	17		LOAD A;@X	Fetch a value
7:	6	1	SUB A;1	Compare it with one
9:	9	17	JUMPNZ;17	Jump if it doesn't match
11:	2	99	LOAD A;99	Fetch count so far
13:	5	1	ADD A;1	Add one to the count
15:	3	99	STORE A;99	Store the new count
17:	15	1	ADD X;1	Point to the next location
19:	9	4	JUMPNZ;4	Repeat unless back at zero
21:	0		HALT	End of program

Listing 2. Searching for a value.

no typing errors, and then RUN it from location 0. As written it searches locations 0 to 99 for the value 1. The total is stored (eventually!) at location 99.

The other problem — multiply A by X — was rather more difficult especially since the 'real' machine code solution involves shifts and binary arithmetic, which are not available in Easycode. The problem was set so that we can demonstrate how the new instructions introduced this month are useful — next month we will compare the refined Easycode with 'real' solutions for the Z80, 6502 and 6809 microprocessors.

Listing 3 uses only the instructions explained so far to perform the multiplication. The result is stored in locations 98 and 99 (the biggest value, 99 x 99, is 9801) and locations 96, 97, 98 and 99 are used for temporary results.

The approach used by the program is quite simple. The value in the A register is added to itself repeatedly. Each time, one is subtracted from the value in the X register. When X reaches zero the multiplication is finished. The program consequently doesn't do multiplications involving 0 correctly, but that would be easy to fix.

There are a number of more serious complications. The first is that we can't add the old value of A to the running total very easily without making the program alter itself (using ADD A;number and 'plugging' the number into the program). Such a solution is rather messy and prone to error. Terrible things happen if the wrong location is accidentally 'plugged'! Instead we store

0:	1	2	LOAD A;2	First No. to be multiplied
2:	11	2	LOAD X;2	Second number (hence 2 x 2!)
4:	13	98	STORE X;98	Save X temporarily
6:	3	99	STORE A;99	Save A too
8:	11	98	LOAD X;98	Point X at the old X value
10:	7		SUB A;@X	Compare the old X with A
11:	8	19	JUMPNZ;19	Jump if A exceeds the old X
13:	2	98	LOAD A;98	Put old X in A
15:	12	99	LOAD X;99	Put old A in X (swap)
17:	10	23	JUMP;23	Carry on
19:	2	99	LOAD A;99	Restore A
21:	12	98	LOAD X;98	Restore X
23:	3	96	STORE A;96	Multiply starts here
25:	1	0	LOAD A;0	Save A, to be added repeatedly
27:	3	98	STORE A;98	Fetch zero to...
29:	2	96	LOAD A;96	Clear the 'hundreds' total
31:	16	1	SUB X;1	Restore A
33:	9	38	JUMPNZ;38	The 'adding loop' starts here
35:	3	99	STORE A;99	Count one less loop required
37:	0		HALT	Plug on unless we've reached 0
38:	13	97	STORE X;97	Store the units
40:	11	96	LOAD X;96	That's all folks
42:	19		ADD A;@X	Save the count for later
43:	8	55	JUMPNZ;55	Point X at the multiplier
45:	3	99	STORE A;99	Add it to the total yet again
47:	2	98	LOAD A;98	Jump if it fitted in A
49:	5	1	ADD A;1	It overflowed, save remainder
51:	3	98	STORE A;98	Fetch 'hundreds' so far
53:	2	99	LOAD A;99	One more hundred
55:	12	97	LOAD X;97	Store the new 'hundreds' total
57:	10	31	JUMP;31	Fetch remainder (units & tens)

Listing 3. A crude multiplier.

the number at location 96 and point X at it, using the ADD A;@X instruction. In turn, we then need to use location 97 to save the count which was in X.

Whenever we add a value to that in A we must check that the total wasn't more than 99, otherwise an overflow (carry) has occurred and we should add one to the 'hundreds' figure at location 98. Look at Listing 3 if this doesn't make sense.

There is one more potential problem. The program so far would calculate 3 x 9 far more slowly than 9 x 3, since the first sum would involve nine additions and the second only three (assuming the second figure was loaded into the X register). This snag is easily avoidable. The program automatically compares A and X at the start and makes sure that the lowest value is in the X register, by swapping A and X if need be.

RUNNING DRY

If this program looks rather daunting, don't worry... WE couldn't make it work for a while! Table 1 shows a good way of testing programs like this. The technique is called 'dry running', and it is rather like running the program on paper before you let the computer at it. Dry running is a very useful skill as it can be applied to almost all languages.

To dry run a program you start by heading a sheet of paper with the names of all the variables or locations which are altered by the program. In the example these are the registers A and X, plus locations 96 to 99 which are used by the 'multiply' program. Dry runs are best for testing programs with few variables — often true of machine code. You need one extra column to record the program line — in BASIC this would be the line number, while in Easycode it is the value of the P register.

TABLE 1							
P	A	X	96	97	98	99	
0	2	-	-	-	-	-	
2	-	2	-	-	-	-	
4	-	-	-	-	2	-	
6	-	-	-	-	-	2	
8	-	98	-	-	-	-	
10	0	-	-	-	-	-	
19	2	-	-	-	-	-	
21	-	2	-	-	-	-	
23	-	-	2	-	-	-	
25	0	-	-	-	-	-	
27	-	-	-	-	0	-	
29	2	-	-	-	-	-	
31	-	1	-	-	-	-	
38	-	-	-	1	-	-	
40	-	96	-	-	-	-	
42	4	-	-	-	-	-	
55	-	1	-	-	-	-	
31	-	0	-	-	-	-	
35	-	-	-	-	-	4	
halt	4	0	2	1	0	4	

Work your way through the program, using a new line every time a value is stored. Write down the value of P as you go along, as a 'key'. The first line stores 2 in register A, hence the '2' in the 'A' column. The next line stores '2' in register X. At any time each current value can be seen by consulting the lowest entry in the column concerned (if there is no entry the value is unknown).

This technique isn't a good way to test a large program (you'd need a sharp pencil and very big pieces of paper) but it is ideal for testing short complicated sections. Dry run Listing 3 (you'll need 20 lines) and compare your results with Table 1.

THE JOY OF STACKS

If you've typed in the new lines you will have spotted the extra column and register on the display by now! The column is the 'stack' and the new register 'S' is called the 'stack pointer'. The stack is an area of memory inside the computer (it could use some of the 100 locations but we chose not to, to avoid confusion). Unlike most memory, you can't put values into the stack willy-nilly -- you have to use special instructions.

The stack works -- as you might expect from its name -- rather like a pile of values. You can 'PUSH' numbers onto the 'top' of the stack or 'POP' them off the top (PUSH and POP are the rather odd programmers' words for put-on-stack and take-from-stack respectively). This kind of stack (there are other, less common kinds) is called a 'LIFO stack' -- LIFO stands for Last In, First Out, and it means simply that the last value PUSHed is always the first one POPped.

Since you can only access the 'top' item on the stack, the computer must have some way of knowing which item is top. This

0:	1	2	LOAD A:2	First No. to be multiplied
2:	11	2	LOAD X:2	Second number (hence 2 x 2!)
4:	21		PUSH X	Save X temporarily
5:	20		PUSH A	Save A too
6:	13	98	STORE A:98	We must still save X in memory
8:	11	98	LOAD X:98	...for the indexed comparison
10:	7		SUB A:X	Compare the old X with A
11:	8	17	JUMPNZ:17	Jump if A exceeds the old X
13:	23		POP X	Put old A in X
14:	22		POP A	Put old X in A (swap)
15:	10	19	JUMP:19	Carry on
17:	22		POP A	Restore A (last in, first out)
18:	23		POP X	Restore X
19:	3	96	STORE A:96	Multiply starts here
21:	1	0	LOAD A:0	Save A, whatever it is now
23:	3	98	STORE A:98	Fetch zero to...
25:	2	96	LOAD A:96	Clear the 'hundreds' total
				Restore A
27:	16	1	SUB X:1	The 'adding loop' starts here
29:	9	34	JUMPNZ:34	Count one less loop required
31:	3	99	STORE A:99	Plug on unless we've reached 0
33:	0		HALT	Store the units
34:	21		PUSH X	That's all folks
35:	11	96	LOAD X:96	Save the count for later
37:	19		ADD A:X	Point X at the multiplier
38:	8	38	JUMPNZ:38	Add it to the total yet again
40:	20		PUSH A	Jump if it fitted in A
41:	2	98	LOAD A:98	It overflowed, save remainder
43:	5	1	ADD A:1	Fetch 'hundreds' so far
45:	3	98	STORE A:98	One more hundred
47:	22		POP A	Store the new 'hundreds' total
48:	23		POP X	Fetch remainder (units & tens)
49:	10	27	JUMP:27	Get the count again
				Do the next add if necessary

Listing 4. A better multiplier.

is where the stack pointer comes in -- it is an index register, rather like X, but it has the special property that its value falls by one whenever it is used to store something. Some computers work the opposite way round, but the principle is the same. The TI-99/4A is the only well-known micro without a stack.

If you look at the 'multiply' program you see that we often have to 'save' and then 'restore' a register value. A stack is an ideal place to do this. Stack instructions can be short since they don't need an address (the stack pointer provides one). You can PUSH and POP numbers at will so long as you always retrieve them in the opposite order to that in which you saved them.

Listing 4 is a version of the 'multiply' program which uses PUSH and POP instructions to save and restore values. Notice that it is shorter and (hence) quicker than the original. It should also be easier to understand. If this explanation has seemed rather daft, type in the program and try it out. Look closely at the way the 'swap' works now.

0:	11	90	LOAD X:90	Point X to start
2:	17		LOAD A:X	Fetch a number
3:	20		PUSH A	Save it on the stack
4:	15	1	ADD X:1	Point to next
6:	9	2	JUMPNZ:2	Round again unless finished
8:	11	99	LOAD X:99	Point back at the start
10:	22		POP A	Fetch last value pushed
11:	18		STORE A:X	Dump it
12:	15	1	ADD X:1	Advance to the next
14:	9	2	JUMPNZ:2	Unless the end is high
16:	0		HALT	Job done

Listing 5. How to reverse values stored between 90 and 99.

STACKS OF PROBLEMS

Stacks can cause crashes! When you use Easycode the computer prints a message if you try to POP a value when S is 0 -- the stack is empty. Another message appears if you try to PUSH when S is 10 -- the stack only has room for 10 items. On the popular small micros there is no check for over-running, or POPping values when the stack is empty -- the computer just overwrites the location after the stack space, or fetches whatever is stored before the stack space. This is usually a disaster. Stacks are useful but they are also the cause of much confusion, so the more you experiment in the 'safe' environment of Easycode, the better.

!ERAWTFOS ESREVER

Unlikely though it may sound, you will often need to reverse the order of values in machine-code programs. One example is the standard way of printing numbers, which involves successively dividing by 10 and printing the remainder. This, unfortunately, gives the answer backwards:

236/10 = 23 remainder 6
23/10 = 2 remainder 3
2/10 = 0 remainder 2

but it is quite easy, using a stack, to reverse the order. Listing 5 does the trick, reversing the values stored between locations 90 and 99.

DON'T PUSH

It may seem rather unfair to be allowed to PUSH the value of A or X, but not P (the usefulness of PUSH S is more debatable). In fact it would be quite useful to be able to PUSH the value of P. It would be a kind of bookmark -- 'this is where I reached when I did the PUSH P'.

BASIC uses a kind of PUSH P arrangement to cope with the GOSUB statement, which has to remember 'where it came from' however many times it is used. GOSUB lets you use the same bit of program over and over again -- wherever you call it from, a RETURN will always get you back. This is harder to program than you might imagine. You can't just use a 'where I came from' variable, because that won't handle GOSUBs within GOSUBs:

```
10 GOSUB 30
20 STOP
30 GOSUB 50
40 RETURN : REM (to 20)
50 RETURN : REM (to 40)
```

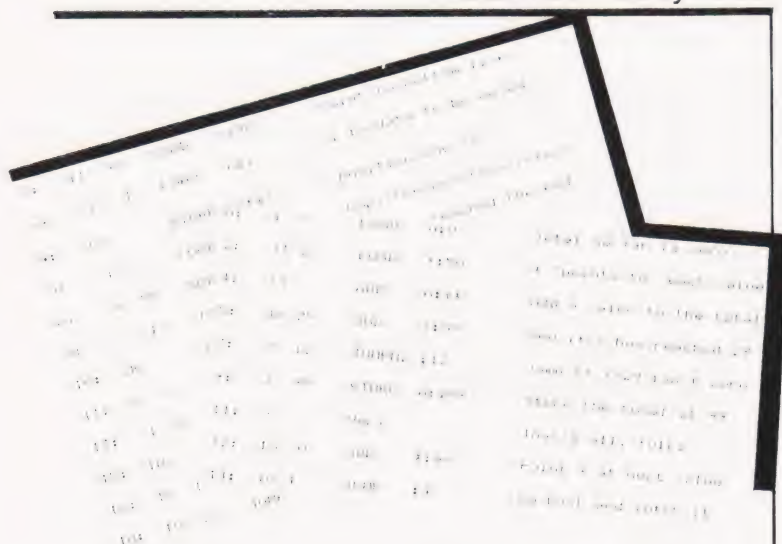
This program would never get back to line 20 if it used a single variable to store 'where I came from'. The GOSUB in line 30 would scrub the reference to line 20 stored by line 10 (we think!). The answer (as you probably guessed) is to use the dreaded LIFO stack, so that each RETURN matches the most recent GOSUB. And that's exactly what BASIC does, which is why a program like:

```
10 GOSUB 10
```

slowly eats up memory until you get an error message when the stack is full (usually something like 'Too many GOSUBs' or 'Out of Memory').

Now we've got a stack it is easy to add GOSUB and RETURN instructions, although assemblers tend to prefer words like CALL and JSR (Jump to SubRoutine) instead of GOSUB. Not being total





masochists, we'll use CALL and RETURN. CALL saves the address of the following instruction (to avoid getting knotted up within a RETURN) on the stack. RETURN fetches the last number off the stack and puts it into the 'P' register — in effect, JUMP @S. To clarify this, try out this Easycode program which is identical in effect to the five line BASIC program:

```
0: CALL;3
2: HALT
3: CALL;6
5: RETURN (to 2)
6: RETURN (to 5)
```

A PRACTICAL EXAMPLE

If you saved Listing 4 you can easily change it into a general purpose multiplication subroutine. Just change the 0 at location 33 into a RETURN (code 25). You use the subroutine by loading A and X and then CALLing location 4. If you're sure that X will always be less than A, you could CALL;19 instead, skipping the swap instructions.

The last program of the month (Listing 6) assumes that you have entered Listing 4 and changed the HALT into a RETURN. The program, which should be RUN from location 60, works out the square of the number in the A register (multiplying A by A). The result ends up in locations 98 and 99, as usual. This will be a

```
60: 1 1 LOAD A:3      Whatever size cell you prefer!
62: 4 4 LOAD A:X      Put the same number in X
64: 24 19 CALL;19     Do the multiplication
66: 0 0 HALT          Easy, wasn't it!
```

Listing 6. Storing A squared at 98, 99.

vastly useful program next time you need to know how many sheets of paper are needed to cover the ceiling of a square room... (always assuming you know the area of a sheet: a CT spread covers about 0.124 square metres!).

There is one crucial thing to remember about programming using the stack. You must clear away temporary results between a CALL and a RETURN — otherwise the computer could try to RETURN to the place A or X pointed to. You can't CALL a routine that goes PUSH A then RETURN — the value of A would 'get in the way' of the return address so that you'd end up 'returning' to whatever address happened to be in A. There are a few occasions in which this is likely to be useful, but not many!

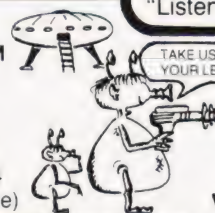
The trick is to make sure that you always POP as much as you've PUSHed before returning from a subroutine. A common mistake is to 'save registers' before a CALL and then try to 'restore registers' inside the subroutine. This doesn't work either — the return address gets in the way.

NEXT MONTH

In the next, and final, episode of this series we'll take a look at real machine code for three popular processors and we'll compare Easycode with the real thing. Since you're unlikely to be able to write the next 'Visicalc' or 'JetPac' in Easycode, make sure of your copy of the June CT!

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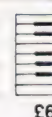
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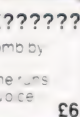
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To be brutally frank, this article has been prompted mainly by self-defence. It doesn't matter how simple a listing is or what machine it is written for: someone, somewhere will not be able to make it work. Human nature being what it is, the immediate conclusion is that it's our fault and pen is put to paper, or mouth to telephone.

Occasionally it *is* our fault, but even in these cases the reader could often save himself a great deal of time and teach himself more about computing if he sat down and tried to fix it on the spot instead of asking us. We will, of course, always do our best to help readers experiencing difficulties with our programs (not your own!) but the more enquiries we have to deal with, the less time we have to actually work on the magazine.

Thus we get a trifle hot under the collar when enquiries arrive that are patently silly. For example, it may seem bizarre but some people don't appear to read the manual supplied with their computer. Often the answer lies there, and a note to the effect of 'Read Page such-and-such' is sent off with barely-repressed

Nevertheless, we can and do take steps to ensure that a program will, under most operating conditions, function without error.

The techniques to be described here are, to the best of my knowledge, those most commonly used, and are the ones which will be of greatest assistance if used thoughtfully and correctly. The methods have purposely been described in relation to BASIC, but since the majority of them are simply embodiments of some concept or other, it should be very easy to recognise their more general appeal. The importance of program structure will also be discussed in order to emphasise the way in which structured design can reduce the number of errors introduced and simplify the debugging process if an error does creep in. First, though, let us examine the ways in which a bug can make itself apparent.

THE EFFECTS OF ERRORS

Program errors can — and will! — make themselves known in such a variety of ways that there is no point and little benefit in

DEBUGGING

Jamie Clary

If you're an Einstein of the programming world or an infallible, letter-perfect copy typist, don't bother going any further. The other 100% of you can carry on reading.

sarcasm. (I know pirated software is circulated without documentation, but surely there aren't pirate computers?)

Another instance occurred just before Christmas, when a reader experienced trouble with a BBC listing. It being a hectic time of year, we couldn't spare the time to find the fault, so we offered to send a copy of the program if a cassette was supplied (NOTE!! This was a once-only spirit-of-the-season gesture, so don't bother writing in requesting software.) The cassette arrived with a copy of his typed-in version saved on it, so we ran it out of interest. The first thing that came up was 'Missing bracket in line 1860'. Aaarrrgh!

In an attempt to encourage a spirit of self-help among readers and hopefully, cut down the size of our mailbag, the following techniques should enable you to tackle most problems yourself. Remember, if one of our programs doesn't work then nine times out of 10 it's caused by a typing error on your part.

THE PROBLEM

A bug, depending on which book you read, is either "something which should not happen when you run a program", or more colourfully "a mistake or problem (possibly simple, possibly very deep); an unwanted and unintended property", or simply "an undocumented feature". The **Hacker's Dictionary** (responsible for the second of the above definitions) goes further and gives examples, such as "There's a bug in the editor — it writes things out backwards" and more generally "Fred is a winner, but he has a few bugs" (ie Fred is a good guy, but he has a few personality problems).

The latter example has captured it quite nicely, by pointing out that a bug can be a local or global phenomenon, and knows little of restraint and other things accept as basic etiquette. More seriously though, the process of detecting and correcting bugs is an art in itself, and it should be treated with as much reverence as actually *creating* a program. Debugging is a process of improving program performance which can range from correcting simple mistakes introduced through carelessness, to, in its most extreme form, re-writing whole sections of code — even the whole program!

The extent to which the debugging process is taken is itself worthy of note. There is practically no way in which any program, excepting the most trivial example, will be tested to a point where it can be considered to be absolutely, 100% bug-free.

trying to list them here. It is, however, relatively easy to classify them in terms of their nature, and with regard to the extent to which they can affect the operation of a program. Broadly speaking, errors fall into two main categories.

The first comprises syntax errors, where the interpreter is requested to acknowledge and interpret a line or command which is inconsistent with its own internal rules. Examples abound, but one which will serve as an illustration is the case where the PRINT statement is simply mis-spelt, such as:

```
10 PRIN "hello"
```

This may appear to be a trivial example, but if this type of error were to occur in a multi-statement line, it could be quite difficult to detect. Syntax errors trapped by the interpreter are usually the simplest to deal with, since one is immediately furnished with information regarding not only the nature of the error, but the line number as well. One often fails to appreciate the importance and usefulness of the error-message, but consider a situation in which a program, merrily executing, encounters an error and suddenly the machine halts — no message — nothing! By these standards (and in the words of Harold Macmillan), we've never had it so good.

However, the use to which we put this information once it is received is quite another matter. Proper and effective use of error-messages is of great importance, as they are normally the first vital link between problem and solution — this will be demonstrated a little later on.

ILLOGICAL, CAPTAIN

The second category of errors are termed logical errors, of which there are three general cases. 'First-order' logical errors (for want of a better term) are those which allow the program to execute as such, but which produce a discrepancy between the predicted and the *actual* result. 'Second-order' logical errors are those which result in elements of a program attempting 'illegal' operations, such as division by zero, string lengths exceeding the legal limit, and so on, and these generally result in premature termination of the program.

Finally, there are 'third-order' logical errors. Detecting this particular breed requires a more intuitive approach than the others, but this does not mean that we are left completely in the

dark. For the time being, though, we could do worse than to define this type of error as 'one which distorts the normal flow of program execution and yet does not return control directly to the user'. The causes are many, as we shall discuss a little later on, but simply put, this variety of logical error will usually occur when the interpreter attempts to interact with the machine at a level beyond the interpreter's environmental control. Obvious examples of such interactions are CALL, POKE, and USR instructions, which have a direct effect upon the system, rather than the very indirect effects of most other BASIC commands.

The greatest problem to be overcome with this type of error is that no hint of the error is given until the situation is well beyond the point of no-return (the machine locks-up or does something similarly anti-social!). Fortunately for us, and unlike so many other systems in our world, a program error will always be a logical consequence or product of some preceding action or series of actions (cause-and-effect, don't you know!) and this alone implies that if we can alter the sequence in some way, the error condition can be prevented from ever occurring.

Basically, all logical errors arise through attempts to code a faulty algorithm, and this of course, will always result in a fundamental weakness in the program design. Fortunately enough, at least for those among us who derive their pleasure from transcribing program listings from the printed page into the micro, this type of error should never be encountered — not in **Computing Today**, at least! (Editor crosses fingers and prays hard).

YOU'RE MISTAKEN

Before embarking upon a full-blown analysis of methods for isolating the more difficult logical errors, let us first investigate the more obvious errors arising from program/language inconsistencies, and attempt to explain in a little more detail, the causes of the commonest errors. In fact, these errors are probably more correctly termed 'mistakes', since they generally result from carelessness while entering the code into the machine, or through mis-interpretation of the printed listing. Examples of this type of error are; confusion over the 'O' and the '0' (zero) characters, confusion over the 'I' and 'l' (one) and 'I' (lower-case L) characters, and quite often, confusion over upper and lower-case variables/procedure names (in BBC BASIC, PROCstart and PROCSTART are not identical procedure identifiers). Luckily enough, the interpreter can often pick up on these errors, and will issue a message pointing to the line containing the offending piece of code. However, this is not the end of the story. For example, in BBC BASIC, if a procedure call is made and the identifier cannot be resolved, as would be the case in the following example:

```
10 PROCstart
20 END
```

```
100 DEFPROCSTART
110 PRINT "PROCSTART, not PROCstart"
120 ENDPROC
```

then the interpreter, rather than exclaiming something along the lines of 'Procedure call error at line 10', indicating that the call at line 10 is incorrect, will in fact issue the message 'no such FN/PROC at line 10'. This, to my mind at least, suggests that the error is not in the 'call' itself, but in the definition of the procedure. So, although the message is technically correct (there is no procedure called 'start' in this case) it mis-leads you up the garden path, because the same message would have been issued had the procedure appeared thus, with the error now in line 100:

```
10 PROCSTART
20 END
```

```
100 DEFPROCstart
110 PRINT "PROCSTART, not PROCstart"
120 ENDPROC
```

This kind of ambiguity can encourage us to investigate the wrong portion of the program, although one eventually discovers the conditions under which such ambiguities can arise, and we soon learn the correct response and correct action to take in reply to

such messages. The techniques to be outlined shortly will contain references to some common mistakes in order to both demonstrate the techniques, and to emphasise the mistakes themselves.

And so, let us turn to some of the methods available which will allow us to discover the whereabouts of errors responsible for program failure. Several comparatively tried and trusted techniques for simplifying the process of fault isolation are available to would-be trouble-shooters, and it is these that we shall concentrate upon in this section. First, let us consider a method which is not so trusted, but is notable in computing circles for reasons which will become quite apparent . . .

TRIAL AND ERROR

Just as in any other fault-finding or trouble-shooting exercise, regardless of the discipline, there is always the possibility that a fault will be discovered by simply applying guesswork to ascertain the faulty element in a system. If one were testing a circuit-board, for example, one could quite conceivably remove every component from the board and test each one out of circuit until the recalcitrant component were discovered. A similar technique can be used to isolate an error in a program.

The minimal requirements for the trial-and-error approach to fault isolation are a blatant combination of acute perceptiveness and good luck! The process itself works along the following lines: bug-finder, observing that all is not well with his program, cultivates a make-shift hypothesis, and goes off for a quick rummage about in the program segment under suspicion. All of this activity is founded upon the assumption that the blighter will have to come out sooner or later, and this, of course, is the basic flaw of this approach. It fails to recognise that bugs are, in fact, quite capable of remaining dormant for long periods without any apparent loss of effectiveness. But if all else fails . . .

PENCIL AND PAPER

The pencil-and-paper method of debugging can offer very good results if its use is correctly regulated. It does require considerable time and effort, though, and often gives rise to some curious physical sensations because of the intense concentration demanded of its user! The technique involves selecting a suitably small, and yet 'complete' section of code — complete in the sense that it must contribute significantly to the routine, procedure, or whatever chunk of program is under test. The process itself involves working through the selected piece of code by hand, performing the calculations and noting values as the computer would when executing the code, in order to determine whether or not the code actually performs its specified function.

The main problem with this method is that a decision has to be made regarding which types of coded operations are suitable for the pencil and paper treatment. Generally, any kind of coded mathematics can be tested in this way, since they can be readily and conveniently simulated by hand. Clearly, one does NOT wish to simulate graphics routines, disc-file updates and so on by hand. Also worth considering is the fact that, by its very nature this method will generate masses of paper, and it is probably well worth investing in a fresh notepad if the piece of code to be tested with this method contains any kind of iterative loop (make that several pads for nested loops!). An added bonus to using the 'pencil and paper' approach, is that it encourages the user to follow the operations of the program step by step, thereby reinforcing his understanding of the language itself, which can't be a bad thing!

BACKTRACKING

In many ways, the process of isolating errors in a program can be made to mirror the original process of program development: by capturing an idea and translating it into another form, we produce a concatenated series of coded events designed to reflect our original idea — a program. Similarly, in attempting to isolate errors — especially those which are due to faulty program design — we can regress from the effects of an error through the preceding program events in an attempt to recapture the subroutine, procedure, line, or whatever, which is reflecting our

original, faulty notion(s).

This particular method, known as 'backtracking' is very powerful. However, it does assume that the person responsible for debugging the program is capable of deducing which portions of a program are responsible for resulting events at any given moment. Clearly, this level of detailed knowledge would only be available to the originator of the program (although this could be a subject of some debate), and those who had studied the fine details of a program and knew it virtually inside-out.

To show how backtracking works in practice, consider the following program:

```
10 CLS: REM ** clear screen
20 INPUT "Your word : ",A$
30 B$=""
40 C$=A$
50 B$=RIGHT$(A$,1)
60 IF LEN(A$)>0 THEN A$=LEFT$(A$,LEN(A$)-1): GOTO 50
70 PRINT C$; "backwards = ";B$
80 END
```

The program above is designed to accept a string supplied by the user, reverse the order of the characters within the string, and finally print the characters within the string in their original and reverse orders. The problem is that when the program is executed, and a string entered, the string purporting to contain the reverse-ordered characters of the original string, turns out to be nothing of the sort! What *is* returned is a null, or empty string. A glance at line 70 reveals that the variable which should contain the reverse-string is B\$. Working back from this line we examine line 60, and find that B\$ is not manipulated at all here, and so we can regress to line 50 for the time being, since it has a direct effect upon B\$. In fact we find that B\$ is *always* made equal to the rightmost character of the string assigned to the string-variable A\$, and this is obviously incorrect! Some further investigation would reveal that line 50 should concatenate a string to 'build-up' the reverse-ordered characters, and should read:

```
50 B$=B$+RIGHT$(A$,1)
```

More significantly, however, the example shows how looking back from the point at which the error revealed itself, helped to isolate the cause. Furthermore, it also illustrated that it is possible for an error to occur some time before its effects are exhibited to the outside world.

The problems associated with isolating the logical error are often compounded by the fact that there can be a substantial delay between the occurrence of an error, and the manifestation of the symptoms, during which time the program may have progressed considerably. This type of error is an obvious candidate for the backtracking treatment since, under these conditions, it is the only possible technique that can be used, *unless* the error can be brought to our attention the instant that it occurs. And this, quite conveniently, is exactly what the next technique is designed to do.

FORWARD TRACKING

The term 'forward tracking' is a little misleading, as the method simply entails following the execution path of a program until it fails to operate as it should. As such, it is probably more correctly termed simply 'tracking'. The forward tracking process can be readily illustrated by the following example:

```
10 DIM A(10)
20 FOR I=1 TO 10
30 READ A(I)
40 NEXT I
50 END
100 DATA 123,456,789,123,0,456,789,123,456,789
```

The program shown is designed to read 10 elements from the data contained at line 100 into a numeric array A(). On execution, the program halts, replying 'No Such Variable at line 30'. Examination of line 30 shows that there are no syntax errors, so where do we turn? We can use several methods to ascertain the cause of the error, but we can start by examining the function

of the program itself. Line 10 dimensions a one-dimensional array; line 20 initialises a FOR-NEXT iterative loop (index-variable I); line 30 takes items of data from the list at line 100, placing the values into the Ith element of the array A; line 40 increments the FOR-NEXT loop; line 50 ENDS the program; line 100 contains the data to be read. So we should eventually end up with an array containing the same numeric values as those in line 100.

Now to the error. If we add an extra line to the program to print the value of the index-variable, I, thus:

```
25 PRINT I
```

on execution of the program we find that I reaches a value of 5 before the program fails. This suggests that the data is read into the array right up until the fifth data-element from line 100 is transferred into the array. This in turn suggests that there could be something wrong with the fifth element of data. So, forewarned by the knowledge that the items in the DATA line can only be numeric values (since the array is a numeric and not a string array), we examine the fifth item of data. Is that an 'O' or a '0' (zero)? We may not be able to say for sure, so we change it to a zero anyway, if only to assure ourselves that it is '0' (zero) and not the alpha-character 'O'. On execution of the program for a second time, we find that the program runs without error, confirming that we had, by mistake, placed the wrong character in the data line.

This underlines two things; how easy it is to confuse the 'O' and the '0' (zero) characters; and how, by tracking the execution of the program, we can obtain additional information about the operation of the program in order to 'home-in' on the location of the error, even though we are lead to believe by the error message that the fault lies elsewhere.

THE SNAPSHOT

This technique involves sprinkling PRINT statements sparingly (take note!) throughout the program, so that at key points during its execution the values of suspicious-looking variables are printed onto the screen. By noting where exactly in the program the print statements have been added, in the event of a variable possessing a value inconsistent with its expected value, we will have an immediate clue as to the location of the offending piece of code (assuming, of course, that you have placed your PRINT statements suitably near to where the calculations have been performed, and not several hundred lines later!).

The most important factors to note about this method are; don't add too many PRINT statements, as the resulting deluge of information could not be assimilated and would be of little use; also, this method assumes that its user is capable of working out by hand the correct values of the variables printed onto the screen. Clearly, there is little advantage to be had from knowing a variable's value if we have no way of testing for its correctness! This technique is of great use throughout all stages of fault isolation, although a word of caution — don't forget where the redundant PRINT statements have been added, as they will crop up at the most awkward and undesirable moments, and can be as much of a headache to weed-out as the errors themselves!

BREAKPOINTS

To be completely accurate, the use of breakpoints within a program (ie inserting additional instructions into a program to suspend the current operation) is another example of forward tracking. However, depending on which machine (and hence which particular implementation of BASIC) is in use, it may or may not be possible to continue execution of the program from the point at which the breakpoint occurred, in order to proceed with the tracking process.

The commonest example of the breakpoint as implemented in most versions of BASIC, is the STOP statement. As you will probably know, on execution of the STOP statement, the host program containing the instruction will cease execution and issue a message to the effect that a STOP statement has been encountered at a certain line. The programmer can then examine the variables and so forth in order to see if everything is

functioning as it should.

Using this method, it is possible to predict where in a program an error is occurring, since (and in the finest tradition of most other forward-tracking techniques) if we can assume that everything is running satisfactorily up to a point, yet as soon as execution of the program is restarted an error is observed, the location of the error is confined to being shortly after the last breakpoint.

Another method which achieves more or less the same result, works by inserting additional statements (INPUT, GET, INKEY etc) to temporarily suspend the execution of a program until such time as a key is pressed. This enables us to examine the output of a program in fine detail, to see if it conforms to our predictions. If, on the other hand, all is not well, then we can halt the program completely and examine the locale for further evidence of an error. There are two points to note here. First, if you expect to be able to continue execution after a STOP instruction, ensure that your particular version of BASIC supports the CONTINUE, RESUME, or some similar command. Second, if you intend to spread redundant INPUT statements throughout your program, DO ensure that the input-variable has an identifier which is NOT used elsewhere in the program, as this is guaranteed to produce some very unexpected results!

INDUCTION

More correctly considered a testing method, induction testing assumes that, if a piece of code works by injecting a certain, known set of values, we can also assume that it will work for ALL input values. These assumptions must be made under certain conditions, as the following example may serve to illustrate.

Consider a routine for producing the multiplicand of two integers, each capable of having possible values lying between 0 and 1000. This simple example alone has 1 MILLION possible input/output variations! The practice of induction involves inserting or replacing lines within the area of the program under test, usually a procedure or subroutine, which presets variables and so on to some value which would normally be derived from some preceding calculation. The routine is then executed and halted as and when the procedure or subroutine has been concluded. The programmer can then proceed by comparing the result with the expected result, concluding that the routine is operating correctly or otherwise.

If the conclusion is that the routine is not functioning correctly, the programmer can continue his investigation by 'forward tracking' or some other method to deduce the precise cause of the error. This method is of particular value when establishing whether or not a routine, which normally would be executed several times or perhaps several hundred times, works just once. The following example demonstrates this process. It can be shown that the SIN of a value X can be developed from the following arithmetic series:

$$\text{SIN}(X) = X - (X/2!) + (X/4!) - (X/6!) + \dots$$

The series itself is unimportant. What IS important, however, is that each successive step requires the factorial (!) of the index or power to which X is raised. The expression for factorial any number, n, is defined as —

$$n! = n * (n-1) * (n-2) * \dots * 2 * 1$$

$$\text{eg } 3 \text{ factorial} = 3! = 3 * 2 * 1 = 6$$

$$4! = 4 * 3 * 2 * 1 = 24$$

and so on

A program written to calculate SIN(X) to seven terms, would require six factorials to be calculated. If the routine to find the factorial of any number were to be entered thus:

```
90 REM ** Routine to calculate factorials
100 TV=N
110 N=N-1
120 TV=TV*N
130 IF N<>1 THEN 100
140 N=TV
150 RETURN
```

we would find that our value for SIN(X) would be very wrong

indeed! To test this routine for its correctness, we could insert the following lines:

```
95 N=3: REM ** Does it work for 3? - Induction
145 PRINT "N Factorial = ";N: REM ** Snapshot
148 STOP: REM ** Breakpoint
```

Calling the subroutine gives the value of 3 factorial as 2 — quite incorrect! Now that the error has been isolated one could examine the routine further, and we would eventually discover, by pencil and paper perhaps, that line 130 should read

```
130 IF N<>1 THEN 110
```

This example also illustrates how several techniques are combined to determine the exact location of the error.

FIRMWARE DEBUGGING AIDS

Most of the methods described thus far are all very DIY and rely largely upon each individual's artfulness. However, there are additional weapons available (at a cost, usually) which can be very useful in a tight spot. The facilities to which I refer are such things as TRACE and FIND functions, as often implemented in add-on toolkit ROMs. The FIND function is an advanced facility which allows the programmer to discover to the exact whereabouts of variables, strings and so on within a program, while the TRACE function is a run-time aid which allows the programmer to follow the execution path of a program by observing the line numbers which are printed onto the screen.

Such tools are generally sophisticated versions of the techniques which have already been mentioned, but their use is greatly simplified. Although any programmer worth his salt could probably survive without such aids (just as any REAL programmer would only work with FORTRAN or better still, assembly language!), such functions greatly reduce the amount of tampering we ourselves have to do to the program, which itself increases the possibility of introducing more bugs into the program than we started with.

ERROR PREVENTION

It is very easy to say that prevention is easier than cure. However, this maxim precludes the fact that we are quite often not responsible for the production of the software we use. The unfortunate truth of the matter is that, although we may not be the originators of the stuff, we are stuck with the task of debugging it if an error arises, and in this case we would just have to get on with the job. When we **are** responsible for designing a program, we can go a long way towards saving ourselves both time and energy, by taking care in the process of specifying and designing the program from the outset. We can go further still, and adopt an approach with the design process which will simultaneously reduce the frequency of occurrences of errors, and cannot fail to simplify the debugging process if errors do creep in (and believe me, they will!). It is normally the case that a program constructed from a number of linked modules will make more effective use of time and energy than a linear or monolithic program.

Another reason why modular or structured programming has enjoyed such great success, particularly in commerce and industry, is that program-development work can be farmed out to several individuals very easily. Although I shall not deal with structured programming to any great depth here (see our previous series *Elegant Programming*), suffice it to say that it does work. The main problem associated with adopting the structured approach is that, by its very nature, it does require the original idea behind the program to be fairly solidly conceived, before the programmer can be allowed even a sniff of the keyboard. Most people find the temptation simply too great to resist!

If the concepts discussed in the preceding paragraphs appear a bit shaky, I can only reply by nodding my head in agreement. The bitter truth of the matter is that the act of debugging a program bears a greater resemblance to economic forecasting than it does to a strict engineering discipline and as such, the process of debugging a program can be no more rigorous than the laws of probability will allow.



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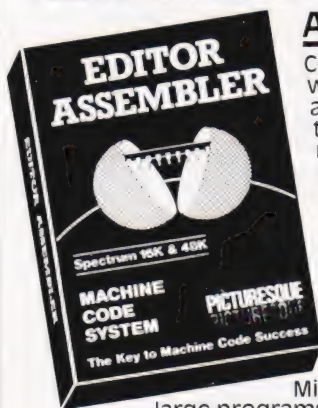
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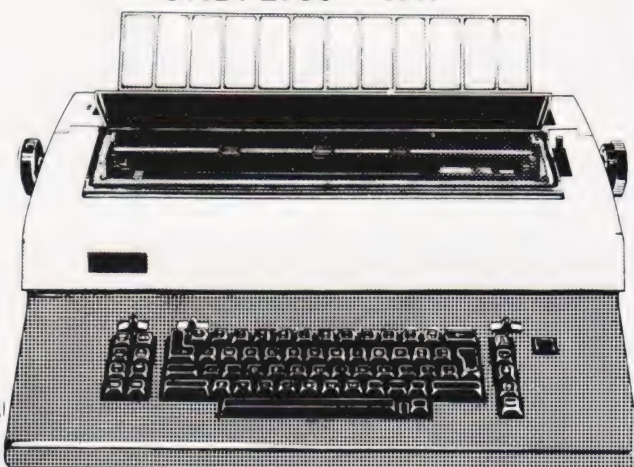
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In case you don't already know, MSX is the new hardware/software standard that has been designed by Microsoft in the United States and taken up enthusiastically by the Japanese, who have launched a myriad of machines onto the market in their own country. It has been taken up rather less enthusiastically in the United States — Spectravideo were the first and, so far, only US hardware company to support the standard, and the Consumer Electronics Show in Las Vegas last year had a distinct lack of MSX machines on show. Nevertheless, it's the US machine that has been the first to reach these shores.

There is also some controversy as to whether the Spectravideo is actually 100% MSX compatible. The story is a little confusing, but it is notable that neither the computer nor any of the packaging sports the MSX logo which licencees are given the rights to.

The main point about MSX is that it specifies a range of hardware as well as the BASIC commands. The spec calls for a Z80A CPU, a Texas TMS9918A (or compatible) video display processor, and an AY-3-8910 (or compatible) programmable sound generator, amongst other things. Together with the standard BASIC and I/O structure, the idea is that several manufacturers can produce different machines, all of which can run all MSX-compatible software.

Although this sounds like a recipe for a string of identical machines, in fact there is a great diversity in the Japanese machines around the basic specification. It also means that the competition between manufacturers to offer better hardware at lower prices becomes a more dominant market factor, since they all have the same operating system, which must be good news for the consumer. What it will do for software piracy is another matter entirely.

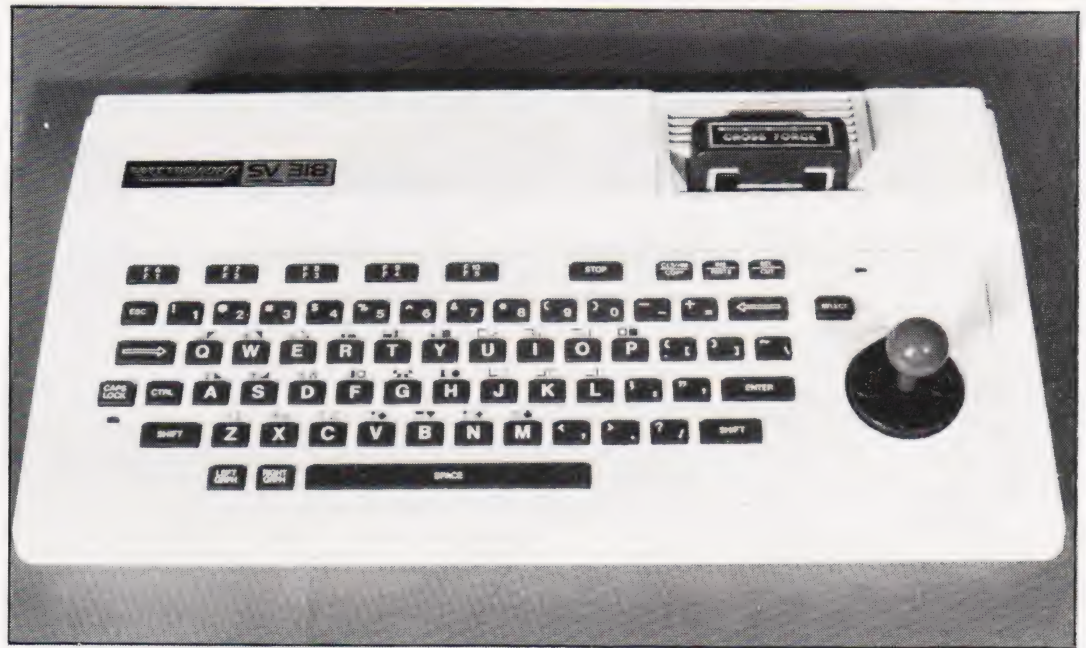
THE HARDWARE

The SV318 arrives in the usual cardboard and polystyrene package, only in rather more bits than you'd normally expect. The basic console looks like a cross between the Atari 400 and a giant Spec-

CHECK THE SPEC

Christopher Moss

The 'Japanese invasion' of MSX machines has been started by a computer from the United States, the Spectravideo SV318/328. Like the curate's egg, it's good in parts.



trum, with a keyboard from the Sord/CGL M5. Overall it's quite a nice-looking machine, cream coloured with dark grey keys. The case is plastic, and the keys are rubber, though the harder type like the aforementioned M5 or Laser 200 rather than the squidgy Spectrum keys. The spacing is similar to that of a full-size typewriter keyboard, but although the keys are the best of the rubber kind, you aren't going to be able to touch-type on them.

If your applications make touch-typing a necessity, then you can buy an up-market version called the SV328 which sports a real moving-key keyboard (plus 80K of RAM). This also differs from the SV318 in that it has a numeric keypad on the right-hand side of the keyboard instead of the 318's built-in joystick. The joystick is not just used for one-player games: it controls

the cursor position when editing programs, and makes the Microsoft screen editor (which has always been my favourite system) even easier to use. If you find that the stick is a nuisance, it can be pulled out to leave a flat 'joydisc' with indentations around the edge for your finger-tips. This is a nice touch (!).

The Spectravideo takes ROM cartridges, and the ROM slot is on the right hand side of the raised area at the back of the keyboard. This is a similar system to the Atari machines, but unlike Atari, Spectravideo have not included a power cut-out switch into the protective flap. Since the manual exhorts you not to insert or remove cartridges when the computer is powered up, this is a potentially dangerous bit of cost-cutting.

Moving on to the right hand side of the case, we find two

ports for connecting external joysticks (for two player games), an on/off power switch (good), and the power socket. At the back of the case there is a ventilation grille, an expansion bus surrounded by metal plate, the cassette port, and the video monitor output socket. The cassette port is a PCB edge-connector, so you'll have to buy the dedicated cassette recorder if you're Joe Average, or get out the soldering iron and wire up a suitable lead for your own machine if you're feeling brave (the pinouts are given in the manual, though not what the signals on them look like).

The computer is one of the larger kind, measuring approximately 16" by 8½" by 3" high at the rear, but even so it needs a lot of other bits to work. The power supply is external, in a small metal box as opposed to the plug-transformer types of power

pack favoured by others. You will notice that I said 'monitor output' in the paragraph above — if you want to use your TV, you'll have to plug in the UHF modulator box, which is small and also heavily shielded by metal. Finally, if you want to use your TV for computing and programme viewing without continually swapping aerial leads, there's yet another small box which plugs into your set and lets you switch between signals.

It all works very well, but you'd better like lots of wires sprouting everywhere, and it's also a good idea to pick a spot where you can plug everything in once and then leave it.

All the heavy shielding does its job, and the design is very nice technically — the picture produced by the review machine was rock-steady and the sound, which is modulated onto the UHF carrier for reproduction through the TV set loudspeaker, was clear and distortion-free. There was no interference at all between sound and picture. It's just a pity the wires and boxes leave a little to be desired from the point of view of ergonomics and aesthetics.

We didn't get any of the other peripherals for the SV318 for this review, but the descriptions in the manual, if they come true, are pretty exhaustive. A game function keypad, external joysticks, graphics tablet and Coleco game adaptor all plug into the basic machine, while the addition of a mother board expander allows the use of various expander cartridges — modem, RS232, 80-column cartridge (for the 80-column printer), Centronics, 16K RAM, 64K RAM and disc drives. The

32K RAM and 32K ROM of the basic machine is expandable to 96K ROM and 144K RAM.

GRAPHICS AND SOUND

Anyone who knows the Texas Video Display Processor chips will know what to expect on the graphics front. There are four different modes available, although the BASIC only allows you to use three of them. The fourth would presumably be available to anyone who can decipher the Texas Data Book on the subject and find where in the memory map the VDP is situated — it looks like two bytes to the computer, and



res mode you get a screen 256 by 192 pixels with 16 colours all available at once (subject to the limitation that you can only have one foreground and one background colour per horizontal group of eight pixels — the manual doesn't tell you this),



uses its own 16K of video RAM. Unfortunately that 16K is included in the 32K that Spectravideo tell you you are buying, so after the operating system has siphoned off its needs you're left with 12816 bytes for user programs. This is a lot less than many machines which do not cost as much: the Electron, the Spectrum, the Commodore 64, the Atmos and the Enterprise, when it's launched.

Still, the graphics are excellent for all that. In high

and 32 sprites which can have their resolution and pixel size altered to give four different sizes. The best way to appreciate what this means is to plug in Cross-force, one of the games cartridges — hordes of aliens sweep across the screen which has various planets drifting in the background. It's quite impressive.

The manual also doesn't mention that the VDP is unable to display more than four sprites on any horizontal line of pixels, which might confuse programmers who haven't read the Texas data sheet and wonder why bits of sprites disappear under certain conditions. It's a minor limitation, though — with enough imagination on the part of the programmer the Texas chip will give graphics as good as most other machines on the market today.

The sound chip is also a good choice. The tone through the TV loudspeaker was clear and didn't have the harsh quality that some computers exhibit. It features the standard range of three tone channels plus a noise chan-

nel, and because the chip handles all the note generation itself, it is easy to have sound playing during program execution in parallel with the game action.

THE MANUAL

Don't judge a book by its cover, goes the old saying, and it is certainly borne out by the manual for this computer. The cover is excellent.

Once you get inside, standards plummet so fast it makes your ears pop. I have seen many manuals for computers, and very few of them could be described as good at the job they are supposed to fulfil: but this manual is quite definitely the worst specimen it has ever been my misfortune to try to comprehend. Let me take you on a guide through some of the better (depending on your point of view) howlers.

I've already mentioned that the manual, to its credit, offers full pin-outs for all its I/O ports, and a rough memory map. Unfortunately it's headed "Appendix E — I/O PIN-OUTS AND MEMORY MAYS", which would shake anybody's confidence in its accuracy. In the so-called User's Manual section, which is supposed to instruct beginners, we find a reference to the built-in 'marco graphic language'. This one really threw me until further on I found the section on the Music Macro Language. A quote from the section on graphics: "That ends our introduction to extended BASIC graphics. Now it is time to move on to the extraordinary sound capabilities of the SV318. Sprites are not limited to only 8 by 8 pixels . . ." The sole demonstration program of how to move sprites by using the joystick ends abruptly halfway through the position update routine and I could find no trace of the rest of it anywhere in the manual. An example of



how to edit a program line has identical 'before' and 'after' diagrams.

I could go on and on in this vein but it's pretty depressing, and rather like shooting fish in a barrel. If the BASIC reference guide and tutorial cassette tape were any better it wouldn't be so bad, but if anything they're worse. I couldn't find a single page that didn't have an error of some kind on it, and the demo examples on tape do absolutely no justice whatsoever to the power of the SV318's sound and graphics. They are pitched at the level of 'the computer picks a random number between 1 and 100, and you have to guess it'. Wow!

Unlike other machines with poor manuals, this is not a manifestation of Janglish. The manual is credited to a group of gentlemen with English names who presumably work for Spectravideo in the USA. They should be ashamed of themselves.

THE BASIC

Since the manual is so impenetrable, it is very difficult to go into any great detail about the BASIC. Where keywords are mentioned at all (some aren't!) they are not explained adequately, and there was not sufficient time to work it all out properly myself in time for this issue. Nevertheless, it's possible to give an overview of the BASIC so that you can get the flavour of it.

The graphics commands are fair, though by no means as comprehensive as a 32K ROM would lead you to believe. LINE allows you to draw a line or, with single letter extensions, draw a box and fill it up. The same applies to CIRCLE, which like most other micros doesn't actually give a circle but an ellipse, due to the aspect ratio of the pixels. The nice thing on the Spec-

travideo is that the CIRCLE command has an eccentricity parameter, so you make a circle a real circle by drawing an ellipse (got that?). It seems almost churlish to point out that the ellipses can only be drawn with their major axis along the X or Y axes of the screen.

Irregular objects may be drawn using the DRAW command, which uses a string consisting of graphics commands from the Graphics Macro language (for example, DRAW "U50R50D50L50" gives a box 50 units on a side). Irregular shapes can be filled using the PAINT command. You can set the screen width, but only to 39 or 40 characters.

The sound functions are utilised by a Music Macro language in the same way that the graphics are — by coding the required notes, tempos and waveforms into a string, which is then PLAYed.

Programmers will find the standard tools available; AUTO, RENUMBER, DELETE and MERGE are present, but there's no FIND and no DUMP. Sigh.

There are some interesting new additions to Microsoft's repertoire in MSX BASIC. You can work in binary, octal or hexadecimal if you wish. You can convert two, four and eight-digit strings to integer, single precision and double precision numbers respectively, and vice versa. You can find the carriage position of the line printer. As well as the usual Boolean operations, there is bitwise implication and equivalence. There are interrupt-driven ON-GOSUBs using joystick triggering, sprite collision and an interval timer.

Of great potential to educationalists is the control, from BASIC, of the cassette motor and the cassette audio output, which can be ported through to the TV loudspeaker

FACTSHEET

CPU	Spectravideo SV-318
Clock	Z80A
ROM	3.57MHz
RAM	32K expandable to 96K
Language	32K expandable to 144K
Keyboard	Microsoft BASIC
	71 keys, hard rubber type
	10 function keys
	built-in joystick/cursor control
Display	24 lines of 40 characters on TV or monitor
	Graphics 64 by 48 low res
	256 by 192 high res
	16 colours
	32 sprites
I/O	Cassette port (1200 or 2400 baud)
	Expansion bus
	Two joystick ports
	Monitor
	Cartridge
Sound Options	Three channels plus noise: eight octaves
	RS232
	Centronics
	Dual disc drives
	Modem
	Extra RAM and ROM
	Coleco game adaptor
	Graphics tablet
Cost	£186 RRP
Supplier	Spectravideo Ltd,
	165 Garth Road,
	Morden,
	Surrey SM4 4LM.
	Telephone 01-330 0101.

via the computer if desired. This suggests excellent possibilities for synchronising audio tapes to the program for teaching purposes.

On the whole, however, Microsoft seems to have been much less adventurous with their 'home computer' BASIC than with their Microsoft Windows for business users. There are no new commands to allow structured programming; no REPEAT-UNTIL, no procedures, no DO-WHILE. Why, I wonder, you can never have enough keywords, in my opinion, and surely there's room in that 32K ROM for a few more?

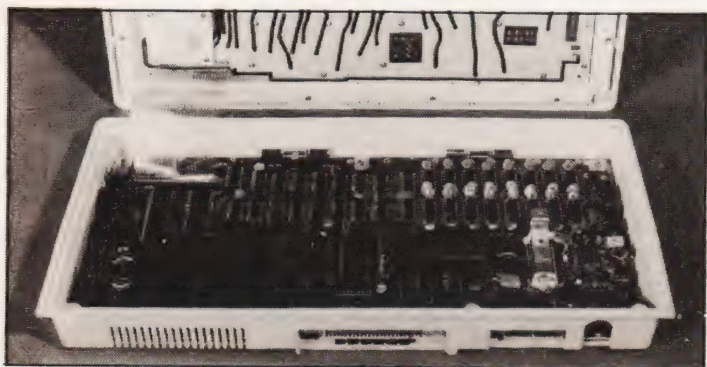
CONCLUSION

From the hardware point of view, the Spectravideo is a very nice machine. The SV318 offers good graphics and sound for the games enthusiast, as well as the facility for some decent, easy-to-use cartridge software. For the businessman, the addition of disc drives to the SV328 will give a system with a decent keyboard and CP/M capability, opening the door to a wide range of off-the-shelf business software. If you can put up

with rubber keys on one hand, or the absence of the built-in joystick on the other, one machine can fulfil either role with equal ease.

What lets the computer down badly is its shoddy documentation. The rank beginner will be totally baffled and even an experienced user is going to have to dig for the information he needs. It seems a shame that such a nice system has been saddled with this manual, and my advice to Spectravideo Ltd would be to get a revised manual written and put into all their stock of machines as soon as possible.

Even if they don't, the book publishers will have their authors working on 'Your Spectravideo Explained' and suchlike (I understand Granada already have such a manuscript ready). But in a market where there are so many machines in this price range offering computing power of a similar level, it will do Spectravideo no good at all to be known as the company whose machines need another £5-10 book before they can even be used properly.





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DRAGON'S BREATH

S.M. Gee

Is twice as much twice as good? The Dragon 64 is here at last and, coupled with disc drives and the new OS9 operating system, it turns out to be a formidable beast.



This review covers three distinct items — the new version of the Dragon, the Dragon 64; the Dragon disc system including DragonDos; and the powerful Unix-like operating system OS9. The Dragon disc system is of interest to existing Dragon 32 owners as it can be used with both versions of the Dragon, but OS9 needs 64K of RAM so it is restricted to the Dragon 64.

Dragon's first machine had considerable success as a home computer, mainly because it offered a good performance for a reasonable price. The points that counted in its favour at the time that it was introduced included a proper keyboard, a range of low and high resolution graphics modes, a flexible sound generator, dual analogue joystick inputs, a Centronics printer interface and a full 32K of RAM.

However, since the Dragon 32 was introduced prices have fallen and the average performance of home computers has increased. To a certain extent this has reduced the appeal of the machine but it is still one of the few low-cost computers that looks as though it might be able to handle a serious application.

However on closer examination it suffers from a number of small but important defects. For example, it takes very little time to discover that the keyboard is not really made for fast typing, there is no repeat key, the text screen doesn't display enough characters or enough lines and the restriction to upper case characters makes text processing almost impossible. The new Dragon 64 offers the same set of positive features as the Dragon 32 but the question is how far does it go in making up for its limitations?

TWO MACHINES IN ONE

You can buy a Dragon 64 without any fears that it might be incompatible with the Dragon 32 because when it is first switched on it is essentially identical to the Dragon 32. In this mode you can load and run any existing software that you have, but of course you cannot make use of any of the machine's extra features. Before going on to describe these extra features available in the Dragon 64 mode it is worth giving a short sketch of the standard features of the Dragon 32 for readers less familiar with the original machine.

In the Dragon 32 there is 32K of RAM, used to provide the memory-mapped video display and to hold BASIC programs. The rest of the address space is used for a 16K ROM containing BASIC,

various memory-mapped I/O devices and 8K of empty space for optional ROM cartridges: see the 32K mode memory map in Fig. 1. Processing is handled by a microprocessor that is relatively unfamiliar in home computers — the Motorola 6809. The fact that a 6809 is used, rather than a Z80 or a 6502, makes very little difference to the BASIC programmer apart from a good speed of execution. The display modes include a 32 character by 16 line text and low resolution 64 by 32 graphics screen. The low resolution graphics can be in as many as nine colours but there are restrictions on how colours can be placed within one character location.

The high resolution modes are given in Table 1. The amount of memory used for any mode increases with the resolution and the number of colours available. The colours



TABLE 1

MODE	RESOLUTION	COLOURS
0	128 by 96	2
1	128 by 96	4
2	192 by 128	2
3	192 by 128	4
4	256 by 192	2

that can be used in any mode are fixed to one of two subsets of the nine possible colours and this can be somewhat restricting. A good feature is that the BASIC high resolution commands treat all of the high resolution screens as if they were 256 by 192. This makes trying out programs at different resolutions easy. The overall quality of the display is quite good and there is an RGB monitor connection if you need a really sharp image. The main problem with the graphics display modes is the absence of any standard way of writing text on the high resolution screens. This can be overcome by various extras but an unmodified Dragon will insist on changing modes back to the text screen to print any system messages etc.

PERIPHERALS

The standard peripherals supported by the Dragon 32 and 64 are a pair of joystick inputs (in fact a six-bit, four-channel A-to-D converter); a single channel D-to-A converter used for sound generation; a Centronics parallel printer interface and a tape interface for a single cassette recorder. The sound generator is almost entirely a creation of software and while there are no built-in commands for sound effects they are certainly possible. Indeed, you can buy a software package that uses the D-to-A converter as a speech synthesiser. However, from BASIC you can only produce 'pure' tones on a single channel.

The sound that the Dragon produces is fed to the UHF modulator and reproduced over the loudspeaker of the TV set. In my opinion this is by far the best way to produce computer sound because it allows you to use a reasonable size speaker, amplifier and volume control for no extra cost! The cassette interface includes a motor control relay and is easy and reliable to use. Some-

times the Dragon cassette interface doesn't work well with tape recorders that have sensitive automatic volume controls, the reason for this being that the tape format uses a leader tone that is far

the I/O area. This means that program cartridges cannot be used in 64K mode, but of course there is nothing to stop you from switching back to 32K mode to use them.

You may be wondering what happens to BASIC when the ROM that contains it is not part of the memory map? The answer is that its contents are copied to the top 16K of RAM where it will run just as effectively as when it is stored in ROM. This is possible because 6809 machine code can be written in such a way that it can be loaded into and

difficult to achieve using other micros such as the Z80 or the 6502. Thus in the 64K mode the BASIC programmer has an extra 16K of memory to play with, making the user and display area 48K. This in itself makes the Dragon 64 more attractive than the 32.

There are two main advantages to storing BASIC in RAM rather than ROM. The most obvious is that if you don't need it you can claim back the 16K of RAM that it occupies and use almost 64K of RAM for whatever you like! The other main advantage is less obvious but still important. Having the BASIC interpreter in RAM means that you can modify it to include new commands and so on. Unfortunately this doesn't seem to be the route taken by Dragon to add the disc commands in DragonDos (see later).

Apart from the increased amount of RAM available in BASIC the only other enhancement that the Dragon 64 offers is a serial interface. This can be used from both 32K and 64K modes and there are two new commands to make this possible. DLOAD and DLOADM can be used to load BASIC programs in ASCII format and machine code programs from another computer equipped with a serial interface respectively. Apart from these the serial interface has to be manipulated using PEEKs and POKEs. However,

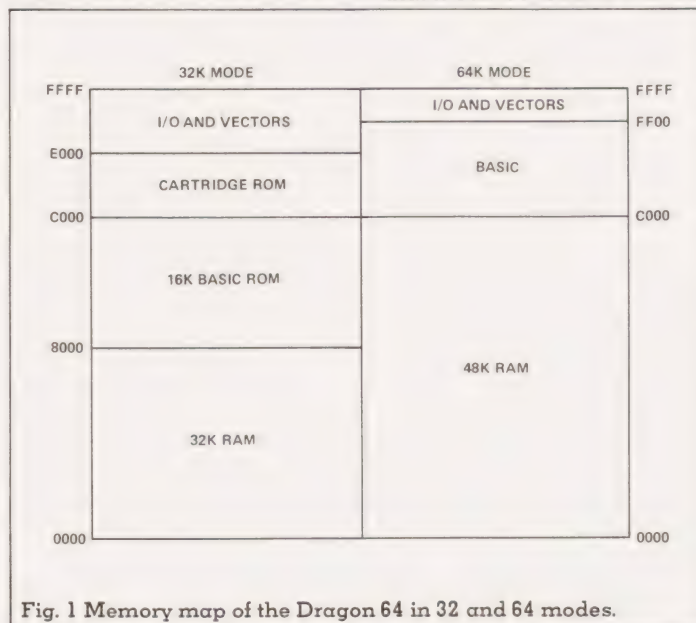


Fig. 1 Memory map of the Dragon 64 in 32 and 64 modes.

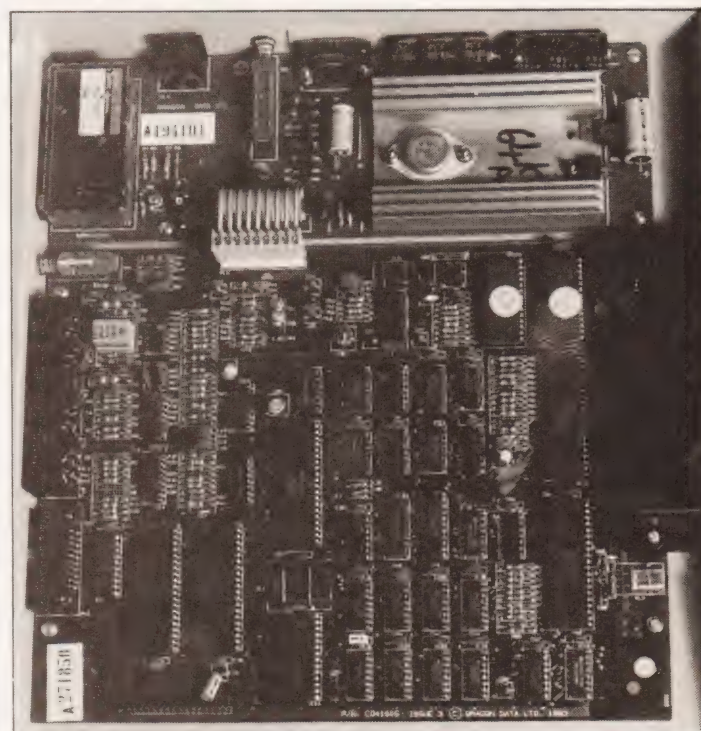
too short for the level to adjust and settle.

The Dragon 32 (and the Dragon 64 in 32 mode) perform well and are easy to use from BASIC. There is plenty of software, literature and support for the machine, partly because it is almost identical to the popular Tandy Colour Computer and partly because of its own established success as a home computer.

64 MODE

If you have a Dragon 64, then by typing a single command you can move from 32K mode to 64K mode. Typing EXEC causes the system to reorganise itself so that the 16K of ROM vanishes from the memory map to be replaced by an extra 32K of RAM (all but a few hundred bytes, that is: see the 64K memory map in Fig. 1). This 32K of RAM not only occupies the address space that was allocated to the ROM, it also takes the area that was allocated to ROM cartridges and part of

executed from any area of memory. This is called Position Independent Code or PIC and it is something that is very



We enter the Dragon!

you can select the serial interface as the output port used by LIST and PRINT#-2 to list programs and print data respectively. The baud rate is software-selectable from 50 to 19200 baud, which should be a large enough range for anyone! The data format is one start bit, eight data bits, two stop bits and no parity bit. The connection to the serial interface itself is made via a seven-pin DIN plug which provides the most common subset of the RS232 signals — TX data, RX data, CTS, DTR and two DC voltage pins, one at -12V and the other at +12V. The presence of CTS and DTR means that the Dragon can support high data transfer rates using 'handshaking'.

housed in a case that is identical to the old Dragon 32 case apart from its colour, the electronics inside have been completely reworked. Even the keyboard, although it has the same key layout, has been improved.

The main PCB contains more or less the same collection of components that made up the Dragon 32 — that is one 6809 CPU, one 6883 SAM (Synchronous Address Multiplexer), one 6847 video display chip, and two 6821 PIAs. The only major change is the use of eight 4864 dynamic RAMs to provide the 64K, and the only major addition is a 6551 ACIA that provides the baud rate generator and the RS232 interface. The changes to the overall board

FACTSHEET	Dragon 64
CPU	6809
Clock	0.89MHz
ROM	16K
RAM	64K
Language	Microsoft Extended Colour BASIC
Keyboard	53 key standard layout with auto-repeat
Display	16 lines of 32 characters on TV or monitor Block mapped graphics on 32 by 64 grid Dot resolution graphics to 192 by 256 16 block graphics characters Eight colours plus black
Cassette I/O	1500 baud with independent motor control Two joystick ports Parallel (Centronics) printer port ROM cartridge slot RS232C Serial interface Sound generator
Options	Joystick unit (pair) £14.95 5¼" disc drive (single) £275 5¼" disc drive (double) £389 OS9 operating system £39.95
Costs	Dragon 64 £225
Manufacturer	Dragon Data Ltd, Kenfig Industrial Estate, Margam, Port Talbot, West Glamorgan, SA13 2PE (phone 0656 744700).

There are also a few enhancements and changes to the code in the ROM. The most important is a keyboard auto-repeat facility. This is automatically enabled when the 64K mode is selected but can be selected in the 32K mode with a few lines of BASIC. The presence of auto repeat certainly makes typing corrections easier.

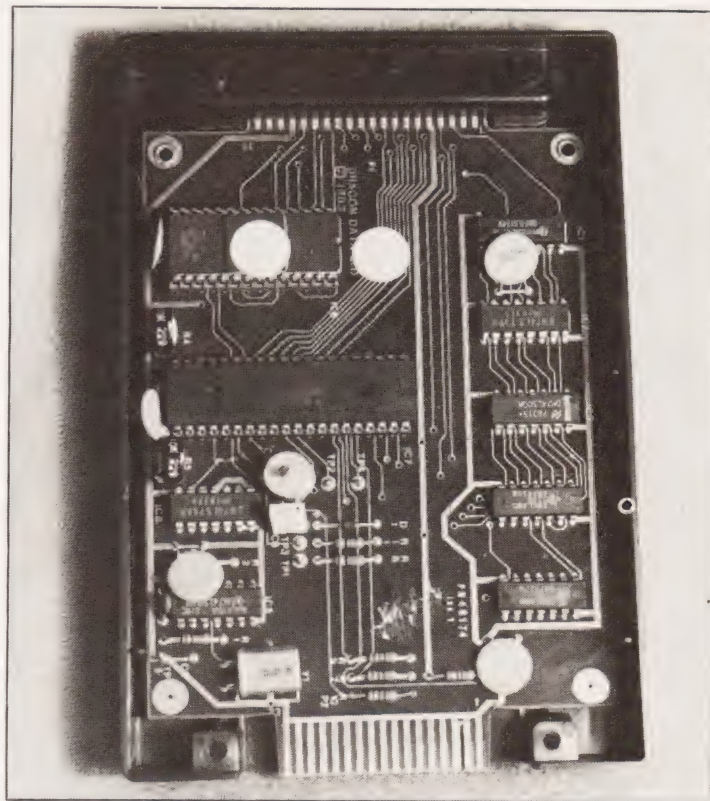
THE DRAGON 64'S HARDWARE

The interesting thing about the Dragon 64 is that, while it is

layout have managed to introduce an additional 24-pin chip without cramming components together and without losing quality of construction.

DRAGON DISC AND DOS

Although Dragon discs and their associated operating system DragonDos are not only intended for use with the Dragon 64, it is this combination that is likely to be popular. The disc interface is connected via the program cartridge connector and in



Inside the disc interface.

appearance is not unlike a large cartridge. Inside there are a few TTL chips, a WD2797 disc controller and 8K of ROM that contains the extensions to BASIC that constitute DragonDos. The disc interface is connected to the disc drives via the usual ribbon cable. Thus installing the Dragon disc system is trivial — plug in the interface to the cartridge slot and connect the cable to the disc drives.

When the disc system is fitted, switching on the Dragon first gives the usual sign-on message and then a second message informing you that DragonDos is active. DragonDos is not a true DOS (Disc Operating System) in the sense of CP/M, say, but is more a collection of extensions to BASIC. There are all the usual and necessary commands that allow you to SAVE, LOAD and RUN programs from disc. You can also copy, back-up and initialise discs.

However, the extra commands for creating and manipulating data files are particularly interesting. The commands FREAD and FWRITE (standing for FileREAD and FileWRITE) will read and write variables from named files without having the use an open command or a

channel number. For example, FREAD "MYDATA";A will read a numeric value from the file called MYDATA and store it in the variable A. This is a particularly easy way of dealing with file operations. If you want a program to process a number of different files then all you have to do is to specify the filename in a string variable. For example:

```
10 INPUT F$
20 FREAD F$;A
```

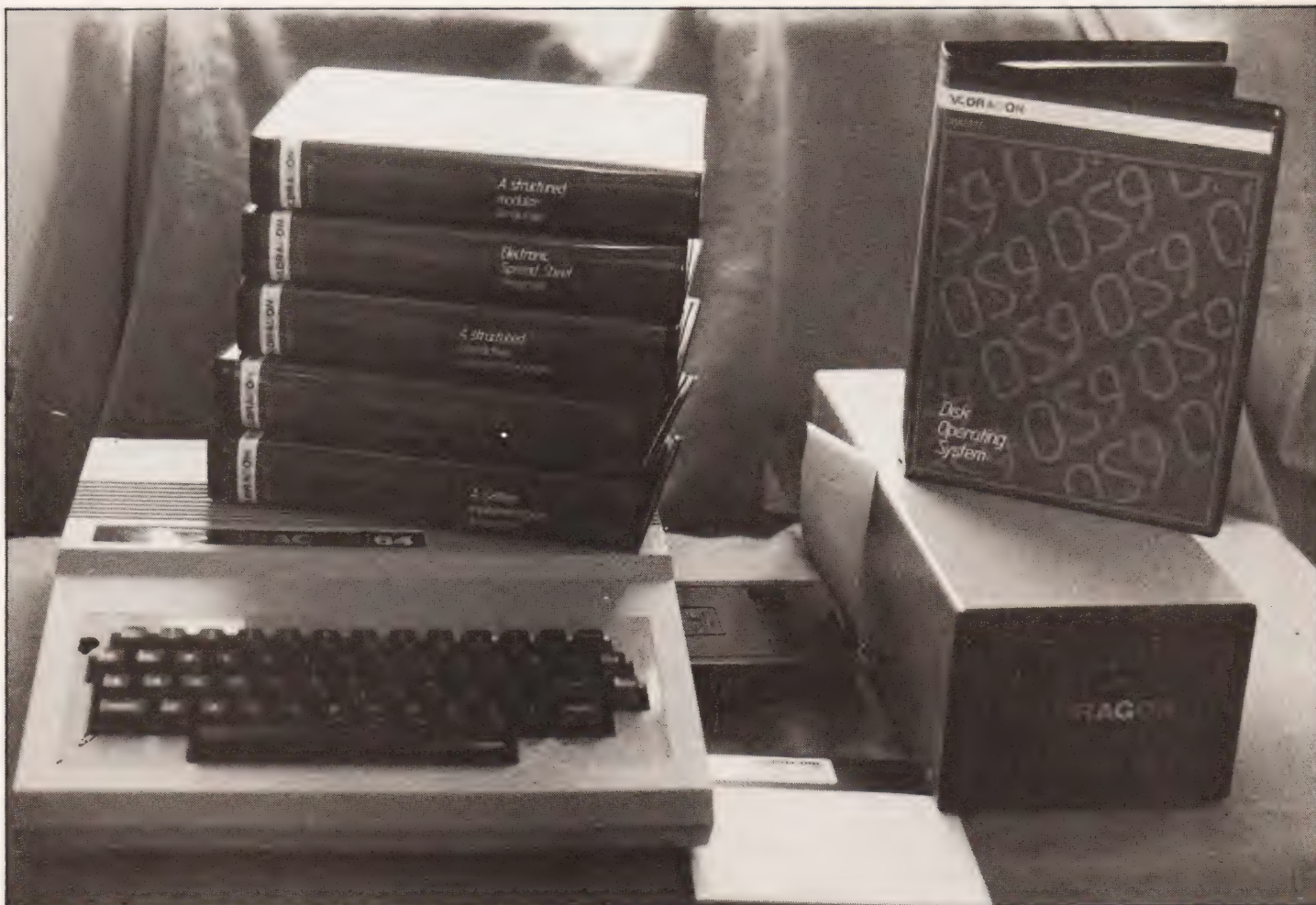
will read A from the file whose name is stored in F\$.

What is even more surprising and pleasing is that the FREAD and FWRITE commands can also be used to handle random access files. The command:

```
FREAD "filename",FROM
start,FOR length;variable list
```

will read data from the file called 'filename' starting at byte 'start' and will read 'length' bytes no matter how many variables are in the 'variable list'. A similar form of the FWRITE command allows data records to be written to any position in the file. Random access is usually an afterthought and very difficult to use so it is nice to see that DragonDos includes this easy-to-use facility.

As well as the file handling commands, DragonDos adds a number of general purpose



commands to BASIC. The most important of these is `ERROR GOTO x`, which will transfer control to line `x` when an error occurs. This is the sort of statement that is essential if the Dragon is going to be used in any serious BASIC applications. Compared to this command the other additions are icing on the cake. The `BEEP` command will make a 'decent sounding' beep, `WAIT n` will cause the program to pause for `n` milliseconds, `SWAP X,Y` will swap the contents of variables `X` and `Y`, `AUTO` will provide line numbers automatically, `FRE$` is a function that returns the amount of space available for strings and `HIMEM` returns the address of the top of memory.

The Dragon discs and DragonDos can be used with the Dragon 32 or the Dragon 64. Indeed there seems to be no advantage in using a Dragon 64 with the discs if all you intend to do is run DragonDos as it will only work in the 32K mode. This is because the DragonDos 8K ROM occupies the address space allocated to cartridge software. In 32K mode the `MEM` function returns a value

of 24809 bytes for usable memory and with DragonDos installed this goes down to 23335.

A REAL OPERATING SYSTEM

Where the Dragon 64 plus discs scores over the Dragon 32 plus discs is that only the 64 can run the OS9 operating system. It is difficult to describe how important this is because OS9 is part of a new generation of operating systems that go far beyond what home users have been familiar with. Perhaps the best known of these new operating systems is the much-discussed UNIX. Although UNIX is a powerful operating system it is very expensive, both in terms of the amount of memory and processing power it needs and its cost. OS9 is best described as being a UNIX-like operating system designed to work with smaller computers based on the 6809. For the features it offers OS9 is also reasonably priced at £39.95.

Getting OS9 running on the Dragon 64 is simply a matter

of inserting a system diskette and typing `BOOT`. After a few seconds of disc operation, OS9 announces itself and asks for the date and time. Following this you are in OS9 and can execute programs, copy and maintain files and perform a whole range of 'housekeeping' tasks that would take too long to explain here. The most important features of OS9 from the user's point of view are multi-user/multi-tasking, device-independent I/O and easy I/O redirection, and a multi-level directory. The trouble is that these are all unfamiliar terms that are difficult to describe briefly. The multi-tasking facility means that you can give the Dragon 64 more than one program to run at a time. For example, typing:

```
DCHECK DO
will test the disc in drive 0 and keep you waiting while it does it but:
```

```
DCHECK DO>RESULT &
will also check the disc but will return control to you before it has finished so that you can get on with doing something else. Ending any command with '&' is taken to mean that you don't want to
```

wait for the task to finish before being able to issue another command.

The `>RESULT` part of the above command is an example of 'I/O redirection'. The program `DCHECK` produces various results while it is running that are normally listed on the screen. To avoid this happening while you are getting on with another job the output is redirected to a text file called `RESULT` that you can list later on when you are ready. In OS9 all devices — keyboard, screen, discs, printer — are treated in the same way and the output of a program can be redirected to any output device and the input taken from any input device.

ON THE LEVELS

One of the main advantages of OS9 is its multi-level disc directory. If you have ever used a large capacity disc drive under a simple operating system you will have discovered the phenomenon of 'file confusion'. If all the files on a disc are recorded in a single directory, then finding the name of a file can be very confusing and a catalogue seems to go on for ever. A

multi-level directory is better because it allows the user to divide up the directory into a number of named 'sub-directories'. For example, all the system command programs in OS9 are stored in a directory called CMDS. On the same disc that holds CMDS you could set up a directory called GAMES where you store any games programs you might have. The command DIR CMDS will give you a list of all the commands in the CMDS directory and DIR GAMES will similarly give you a list of all the games in the GAMES directory. This use of different directories for different types of file makes keeping things orderly very easy and if more than one person is using the same disc it is essential!

I LIKE UNIX — LIKE OS9

I have used UNIX on largish computers and another 6809 UNIX-like operating system, UNIFLEX, with a small system using 8" discs, but sitting in front of the Dragon 64 with a pair of 5¼" drives running OS9 was an odd experience. Using an operating system that behaved in a way that I have come to associate with large computers on a machine that I cannot help thinking of as a small computer is a disorientating experience. After a few minutes I have to admit that I liked it! An enhancement that is worth its weight in gold — a 51 character by 24 line display with both upper and lower case characters — can be selected at any time while OS9 is running. This really does help make the Dragon 64 look like a big machine. This improved screen is produced by using the high resolution graphics screen to draw limited definition characters. Hence the quality of the display is not perfect but it is very acceptable.

I am impressed by OS9 but there are a number of problems. The first thing to say is that OS9 seems to be slow when performing simple disc operations when compared to other 6809 operating systems such as FLEX or even Dragon-Dos. Also there are a number of implementation bugs on the version I tested that while, being minor, were irritating. For example, when another task that uses the disc exten-

sively was set running it proved almost impossible to type in another command with the 51 by 24 line screen selected. The keyboard was extremely sluggish and this suggests that Dragon need to pay some attention to their keyboard driver. When I tried to conduct the test model with the usual screen selected the problem was even worse in that a section of the keyboard was being incorrectly decoded, giving double characters for each key press. However, this problem seemed to come and go each time I re-booted the system — very strange. Once again, it sounds as though Dragon need to attend to their implementation of the OS9 keyboard drivers.

Implementation problems apart, I have to say that I am very optimistic about the OS9. There is a great deal of good quality software that will run under it — BASIC 09, C compiler, Pascal, Dynacalc (spread sheet), Stylograph (text processor), record management, cash and VAT and stock recording — all for reasonable prices between £49 to £79. OS9 is so like UNIX that anyone that has used UNIX will soon settle down with OS9 and vice versa. If Dragon get rid of the few bugs in the software and offer some faster disc drives OS9 will be unstoppable!

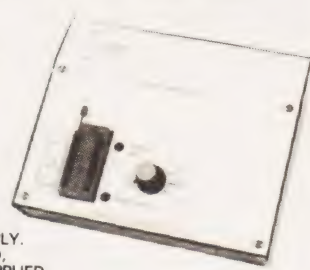
BETTER?

The opening paragraph of this review posed the question of whether or not the Dragon 64 has overcome the problems inherent in Dragon 32. If the Dragon 64 is taken on its own then the answer must be that it is better but not much better. Essentially it offers 24K of extra user memory, a serial interface and an auto-repeat facility. When added to the Dragon disc drives and Dragon Dos then the memory advantage seems to vanish and the only difference between the Dragon 32 and the Dragon 64 is the serial interface. But if you add the extra ingredient of OS9 the Dragon 64 really moves into a class of its own and the answer to the question must be yes! OS9 transforms the Dragon 64 into a super computer and provides a taste of things to come.

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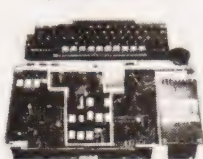
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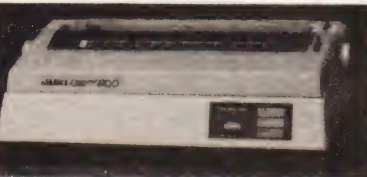
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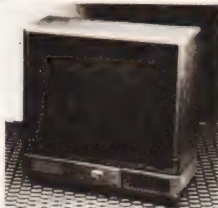
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ELECTRONIC MAIL

Julian Allason

When the mail service first started, it was possible to write a letter, get a reply the same day and mail your own response too. Progress has changed all that, but now technology means that the good old days of quick delivery and quick response may be back again.



Imagine posting a letter and receiving a reply the same day. My aunt Lola used to when she lived in London before the war. These days, she is lucky to get a reply in less than three days. And that is by first class post. But what if you could have a reply within five minutes, and for less than the cost of a second class stamp?

Well, you can, using electronic mail. You will need a little more equipment than the traditional fountain pen and bottle of Quink Permanent Blue-Black ink, of course. But the chances are you already own most of it. For electronic mail is simply the passing of messages from one computer to another.

Sometimes the message will travel over the public switched telephone network, in which case an acoustic coupler or modem will be

required to connect the computer to the telephone line. Alternatively, many companies with more than one microcomputer are linking them directly together into a Local Area Network. In this case, no modem is necessary, and no special software either, since electronic mail is normally provided as a standard feature of the networking system itself.

LOCAL AREA NETWORKS

This sort of networked electronic mail enables you to send memos, letters, tables of figures, even data files from one terminal on the system to another. This is fine when communication is only required between individuals in the same or adjacent building. Most local area networks have a maximum geographi-

cal distance and are limited to a distance of between one and 10 kilometres. So if you need to communicate with computers that are physically remote, or perhaps belong to people outside your own organisation, it may be better to consider one of the public electronic mail services.

There are several of these, the best known of which is British Telecom's own national electronic mail service,

Telecom Gold. Many personal computer owners will know this as **Micromail**, the name for ACT's single sourced service which includes user-friendly software capable of dialling the user's mailbox up automatically. This package costs £95 plus VAT for Sirius, Apricot and IBM Personal Computers, or £295 including an autodial modem card that fits inside the computer.

The next most popular

HOW TO POST AN ELECTRONIC LETTER

To send a message via one of the public electronic mail networks, it is first necessary to dial up the central mailbox computer. This may be done manually by the user, or automatically by the computer if an autodial modem is fitted. If the subscriber is more than a local telephone call away from the mailbox computer, he should be able to dial the number of the nearest entry point for British Telecom's Packet Switchedstream Service. Known as PSS, it enables information from computers to be sent down high speed data lines without incurring long distance telephone charges.

Once a connection is established, the central mailbox computer will identify itself and display a message on the screen inviting the user to log on with his identity number and personal password.

A prompt then appears on the screen, to which the user responds by typing "Mail" or the name of whatever other services is required (these can include facilities like electronic diary). If Mail is selected, the system responds by asking if you wish to SEND, READ or SCAN. The last named command enables one to review the subjects of incoming letters and the names of senders.

Normally, however, a user would simply READ all new letters in turn. Once read, the message may be deleted, filed under a particular heading, replied to or simply left on the system as a letter that has been read. One then proceeds to the next item of mail, replying where a response is required.

Sending an electronic letter is simply a question of responding to prompts asking for the name, or mailbox number of the addressee and the subject of the message. If a name is given, the central computer automatically ensures that it goes to the correct mailbox. Users can maintain their own circulation lists so that copies could be sent to, say, all executive directors, all dealers, or a named list of up to 500 subscribers.

Once the text of the message has been typed in, it can be edited before being set. If, however, the message is a long one it is easier and cheaper to prepare it offline using an ordinary word processing program and simply dump the text file down the line instead of typing the message in live on the system.

nationwide system is **Comet**, operated by BL Systems. Similar to the basic Telecom Gold, it enables subscribers to send and receive messages from each other, but not from Telecom Gold/Micromail.

Both services work on a store-and-forward bureau basis. That is to say that each subscriber has his own electronic mailbox to which mail is sent. Typically he will dial it up two or three times in a working day to read, and perhaps print out, messages that have come in in the interim.

A single page 400 word message could be sent by a subscriber in Manchester to one in London for 17p. A reply sent off-peak could cost as little as 12p using Telecom Gold. By comparison, a telex message of the same length would cost three times as much, one sent by facsimile transmission about five times as much, and Datapost no less than 20 times as much.

PRESTEL AND MICRONET

At the cheap and cheerful end of the market is the **Prestel**



service's own mailbox facility. Both this and the electronic mail service offered by Prestel information provider, **Micro-Net 800**, suffer a number of limitations which make them unsuitable for other than occasional business use.

The first of these is the restricted number of words per-

mitted by the Prestel screen format. This effectively limits the length of a message to 400 characters, about 70 words, as only a single screenful can be sent at a time. Mailboxes are very popular with home computer owners subscribing to MicroNet.

OTHER ELECTRONIC MAIL SERVICES

British Telecom offers a sort of electronic mail service of its own. The disadvantage is that the message is transported electronically for only part of the way.

The **Telemessage** service replaces the late lamented telegram, which it closely resembles. The text of the message is dictated over the telephone to an operator. Thereafter it is transmitted by wire to the Telemessage

centre nearest to its addressee. The printout is then consigned to the mercies of first class mail in the ordinary way. The cost of sending a 200 word electronic letter by Telemessage would be £7.50 plus VAT.

FACSIMILE

The term electronic mail is also bandied about by marketing men seeking to promote the public Fax services of British Telecom and the Post Office. Neither enjoy the cost or speed benefits of true electronic mail, since the original document must be taken to the sending station and delivered onwards from the receiving station by hand, or more often these days, by motorbike.

Fax does enjoy one advantage over electronic mail and that is that it enables drawings and signatures, not just alphanumeric characters, to be transmitted. Future electronic mail development is, however, likely to include some graphics capability. The principal stumbling block is the varying graphics standards used by different types of computers.

TELETEX

The fourth alternative is **Teletex**, often described as super telex system. Like local area networks, but unlike everything else, this permits electronic letters to be sent directly from point to point, as opposed to being dumped into a central mailbox computer. In consequence each Teletex terminal has to include the full message handling software, making it a relatively expensive proposition. It is also necessary to leave the terminal switched on

THE HARDWARE YOU NEED

Virtually all but the cheapest home computers can be used as electronic mail terminals. Two things are needed: a special program to handle the communications and a means of connecting the computer to the phone line. The cheapest of these are **Prestel** adaptors. Priced from £50 upwards, they are essentially simple modem devices with special software to handle the unique Prestel character set. They are **not** suitable for use with other forms of electronic mail.

Acoustic couplers, which cost from £150, used to be the cheapest way of connecting a computer to the telephone. Operating at 300 bits per second (equivalent to about 250 words a minute), they can be used with an ordinary telephone handset which is inserted in the coupler's rubber cups.

A new low-cost modem called the Buzzbox is now being marketed at just under £100, however. This plugs into a telephone jack socket in place of the telephone and directly modulates the electronic current carried by the telephone line. In practice such devices operate at around twice the speed of the acoustic coupler, which must convert the digital signal from the computer into audible pulses.

External modems operating at faster speeds are available but tend to be pricey. A better bet is the onboard autodial modems now being offered by some microcomputer manufacturers. Fitted inside the microcomputer, these will dial the mailbox computer automatically. Typical price: around £300, although for slightly less than this **Micromail** offer an onboard modem, software and subscription to their Telecom Gold based service — but only for Sirius and Apricot at present.

Some microcomputers, notably the Torch range, have a modem fitted as standard. It is probable that most manufacturers will follow their lead in due course.



OUR EXPERIENCE

We tested electronic mail on Prestel using a Tandata adaptor, Telecom Gold on an Epson HX-20 portable computer with a Sendata acoustic coupler, Micromail on a Sirius with an Anderson-Jacobsen acoustic coupler, and Torchmail point-to-point communication between Torches using the built-in modem.

All the systems tested displayed erroneous characters at some stage, displaying a lack of tolerance for our doubtless less-than-perfect telephone lines. We had the most trouble with the Epson which used a technique of continuously squirting characters down the line to the host computer, without waiting for a response. This was probably the reason why the Epson proved the least tolerant of noisy lines. A pity, since the combination of Epson and Sendata acoustic coupler (powered off the HX20's battery) was the only one remotely small enough to be used as a portable terminal. We understand that the software has since been improved, however, so this problem may now have been resolved.

The Torch also displayed occasional temperament if the telephone line was not to its liking. A further problem arose whereby all text displayed on the screen became garbled. Our initial suspicion that this was due to a software fault gave way to a conviction that the problem lay in the keyboard, a fault Torch subsequently conceded knowledge of. This, too, has since been rectified, we understand. Difficulties were only experienced when accessing Telecom Gold. Point-to-point communication between Torches performed without a hitch, and the company are to be congratulated on their imaginative use of colour on the Torchmail screens. Such communication does, however, presuppose that the computer being called is connected to the telephone more or less permanently.

The Tandata adaptor performed well and proved as tolerant of our telephone lines as the more expensive Sony and Plessey systems tested for comparison. Our biggest problem was with the restricted Prestel screen format which limited the number of words in a message. None of the Prestel adaptors and terminals we tested were satisfactory for touch typing (although Sony do offer a typewriter keyboard as an optional extra). This hardly mattered as messages were of necessity short.

The friendly Micromail software took the pain out of logging onto Telecom Gold, but could do nothing to ameliorate the latter's obsolete text editor. It proved cheaper and in every way more satisfactory to prepare all but the shortest messages offline, using a word processing program and send the text file. At present there are only about 40,000 people on Telecom Gold so it won't replace telex or the postman overnight. But in the long run it could well be the winner.

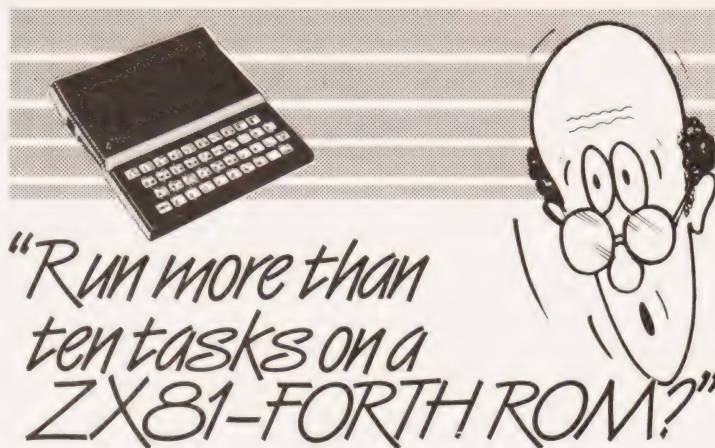
all the time.

Right now Teletex looks distinctly green around the gills. Several of the original manufacturers participating in the scheme have dropped out, while the majority of those left in have experienced problems getting their hardware approved by British Telecom for use over ordinary telephone lines. It is our belief that unless a major microcomputer manufacturer steps in and includes Teletex software as standard, this system will never take off.

Our advice is therefore to opt for a Local Area Network, if your requirement is to communicate with computers that are not physically remote from

each other. The best and most user-friendly national electronic mail service is undoubtedly Micromail — but only if you own an ACT or IBM personal computer. (I'm sure that Julian's connection with ACT in no way influences this decision! — Ed). Otherwise Telecom Gold looks to be a slightly better bet than Comet.

Home computer users will find MicroNet 800's mailbox service fun to use, and of course they will still have access to all the standard Prestel services as well as MicroNet 800's bank of free software.



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MAKE MONEY WITH YOUR MICROCOMPUTER

Most people buy a micro *either* to play games, like 'Invaders', on it ... *or* to learn more about computers ... *or* as an educational aid for their children. But now, there is another — **potentially far more exciting** — way to use your microcomputer.

The fact is, *your micro can do the same amount of work it took several people many hours to do only a few years ago* ... in a matter of minutes. What's more, most of your expenses are already covered — electricity, rent, rates and even the computer itself ... they're all paid for. So **any money you bring in with your micro should be almost pure profit**. All you need now is the 'inside track' on who needs which services where, how to get them to sign on with you and what to charge.

New Guide Tells All

"**Make Money With Your Micro**" is a new, working manual that answers all these questions ... and a lot more besides. Like **how to set up a small computer business** ... what books to keep ... when to call in professional help ... how to arrange your workspace to maximum advantage ... **why the right micro based business can be unusually profitable**, and what you need to climb on the bandwagon ... before it really gets rolling. Here is a brief sampling of what else you can expect to learn from this special report:

What You Will Learn

- * Where to find customers ... and what to offer them.
- * Why word processing is different ... and some rather surprising, little-known, ways to make it pay big.
- * How to save businesses money ... and make yourself a small fortune in the process.
- * Which number services pay best ... and how to perform them efficiently.
- * Where to get referrals ... and why they matter.
- * Managing your time ... always important, but vital if you plan a part time operation.
- * Preparing mailing lists ... why this is potentially one of the most profitable services you'll be offering.
- * And much, much more.

Where Do I Find Customers?

In addition to taking you through the very necessary steps that precede any truly successful microcomputer-based business, "**Make Money With Your Microcomputer**" gives you the low-down on exactly which businesses want what services, and how best to get these firms as big paying customers.

Working from this profession-by-profession section, you can find several openings available right now to suit your circumstances — areas where you, with your micro, can really *coin* money ... giving people and businesses in your part of the country what they want and need to become more efficient ... and, therefore, more profitable.

Do I Need Capital?

You don't require any 'capital' as such to get started in this microcomputer business ... remember, what we are talking about here is primarily a service industry. You can work from home, in your own time at your own pace ... starting with just a couple of evenings a week only, if you like. There's no need for 'staff' ... *your micro does the hard work for you* ... and your 'office' is already paid for because this, more than any other business in the world, takes very little space ... almost any quiet corner will do.

Must I Be An Expert?

It really doesn't matter if you don't know a lot about computers, because there are plenty (almost too many!) 'ready-made' programmes already on the market ... most of them with built-in instructions ... covering just about every and any computer job you are likely to encounter in your new business. But, naturally, if you can design your own programmes, and that is what you enjoy, there's nothing to stop you doing so — although, frankly, the chances are there's a better, less expensive programme already in existence.

Which Micro Do I Need?

Almost any modern micro will do, because most programmes these days are — or can be made — compatible with just about any other microcomputer. If you haven't yet bought your own micro, you'll find the cost surprisingly low ... and certainly very small compared to its earning potential. However, either way, you may need a few 'add-ons' ... although, again, these cost very little when you consider how much money they can make for you.

An Alternative Service

If you prefer offering a service direct to the public, you'll also find in this new manual a special section devoted to areas where you can do just that. But, it's only fair to tell you now, you are likely to *make much more money helping companies* and the professions (e.g. Doctors, Architects, etc. etc.) than you ever could selling services direct to the public.

Get There First

As with any other business, to be successful you must find a need and fill it. Right now, there are literally dozens of companies and professions in your area that urgently need micro based help. The *big* money in this field will be made by those men and women, young or old, who are first to sign these businesses on as customers, and then grow with them.

Your Guarantee

"**Make Money With Your Microcomputer**", the practical, working manual that can guide you into this exciting new field, costs just £10, post paid. There is a 30 day satisfaction-or-your-money-back guarantee, so all you are risking to find out more about what could be the fastest growing part of our economy over the next few years is a few postage stamps.

How To Order

To order your copy now, just complete the form below and return it here. And, remember — the sooner you get it, the sooner you too can "**make money with YOUR microcomputer!**"

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"MAKE MONEY WITH YOUR MICROCOMPUTER"

CT/00/05

To: Chartsearch Ltd., 11 Blomfield Street, London, EC2M 7AY.

Please send me one copy of "**Make Money With Your Microcomputer**" as soon as possible for which I enclose payment of £10 (includes postage and packaging)

- ☐ Cheque/Postal Order of £10 enclosed
☐ Please charge my Credit Card as follows:

A/C number _____ (Access/Visa/Diners/Amex)

From: _____ BLOCK
Name _____

Address _____ CAPITALS
_____ PLEASE

Postcode _____

Signed _____ Date _____

READER'S SURVEY

Here's your chance to tell us what you think of the magazine once again, but this year the survey form has a business reply service format, so you really don't have any excuse not to send it back. As you may have noticed, from this issue Computing Today has been merged with MicroComputer Printout and Business Micro, so changes are afoot. If you want to influence those changes, turn the page and start filling in the boxes. We've made as much of the survey multiple-choice as possible, to make things even easier for you. However, we can't think of everything and space has been provided for any additional comments you might like to make. Please feel free to be as nice or as nasty as you wish.

Because this survey is reply-paid, a little more origami is required than in previous years. First, pull out the survey form from the magazine and fold it along the page fold. Then fold along the line at the centre of this page. Finally, fold the two flaps marked second and third folds, tuck one into the other, and make sure you've done it so that the address and licence number are showing. Please refrain from 'making sure' by using staples, sticky tape, Blu-tack or anything else — it takes us ages to get the things open without tearing them!

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TUCK IN

THIRD FOLD

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ARGUS SPECIALIST PUBLICATIONS LTD,
NO. 1, GOLDEN SQUARE,
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W1R 3AB
UNITED KINGDOM

SECOND FOLD

ISSUE ISSUES

1. Please rate the general features below which have appeared in the last year. Leave all the boxes blank if you didn't read an article. Ratings are 1-Poor: 2-Fair: 3-Good: 4-Excellent.

	1	2	3	4
NASPEN Append (Apr)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Froglet (Apr)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Valley Variations (Apr)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pascal Profile (Apr)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Micro Database (Apr)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lower case UK101 (Apr)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Into Atari's BASIC (May 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Going FORTH Again (May)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Micro Interruptions (June)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Making Music (June)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tube Cube (June)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Beating the RS232 Blues (June)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Indexer (June)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Atari Renumber (June)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweet Sixteen (July)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bomb Proof Tandy (July)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Genie Space Saver (July)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Format Converter (July)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16-Bit Survey (July)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Micro Interruptions (Aug)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sharp Speed Up (Aug)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BBC String Store (Aug)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Planetfall (Aug)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FELIX Knowledge Shops (Sep)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Software Protection (Sep)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ZX81 Backgammon (Sep)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dragon Character Generator (Sep)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Slingshot (Oct)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Non-destructive Cursor (Oct)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Z80 Disassembler (Oct)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A Better TRSDOS (Oct)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BBC Word Processor (Nov)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rescuing Source Code (Nov)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adventures Part 1 (Nov)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FORTH Floating Point (Nov)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tape Append (Nov)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dragon 'Graphics' (Dec)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MCBAS Converter (Dec)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adventures Part 2 (Dec)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Curve-Fitting (Dec)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BBC Touch Typing Tutor (Dec)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The Programmer's Aid (Jan 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Some Notes on the Apple (Jan 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4

Named Files for NAS-SYS (Jan 84)

Atari Disc Library (Jan 84)

TRS-80 Screen Editor (Jan 84)

Make a Date (Jan 84)

Using MX-80 Graphics (Feb 84)

Colour Genie Monitor (Feb 84)

Non-random Numbers (Feb 84)

Notes on the Apple Pt. 2 (Feb 84)

Two PET Utilities (Feb 84)

Program Recovery on the

Commodore 64 (Feb 84)

BBC Poker (Mar 84)

Genie Utilities (Mar 84)

Spectrum Centronics

Interface (Mar 84)

Poker Part 2 (Apr 84)

Genie Commands (Apr 84)

Disassembly Techniques (Apr 84)

Recursion (Apr 84)

Debugging (May 84)

Electronic Mail (May 84)

Upgrading Your WP (May 84)

Your Questions Answered (May 84)

Computers and the Commons (May 84)

Z80 Text Compactor (May 84)

Word-wrapping (May 84)

2. Please rate the features below which appear more or less regularly in Computing Today.

News

Printout

Club Call

PROCopinion

Book Page

3. Please rate the following series which have appeared in Computing Today over the past year. If you didn't read the series, leave the boxes blank.

Getting More From The 64

Going FORTH Again

Languages in Use

Learning FORTH

Problem Page

Easycode

4. How do you rate our hardware reviews, in general?

5. How do you rate our software reviews, in general?

	1	2	3	4
Named Files for NAS-SYS (Jan 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Atari Disc Library (Jan 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TRS-80 Screen Editor (Jan 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Make a Date (Jan 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using MX-80 Graphics (Feb 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Colour Genie Monitor (Feb 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Non-random Numbers (Feb 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes on the Apple Pt. 2 (Feb 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Two PET Utilities (Feb 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Program Recovery on the Commodore 64 (Feb 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BBC Poker (Mar 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Genie Utilities (Mar 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spectrum Centronics Interface (Mar 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Poker Part 2 (Apr 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Genie Commands (Apr 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Disassembly Techniques (Apr 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recursion (Apr 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Debugging (May 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electronic Mail (May 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Upgrading Your WP (May 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Your Questions Answered (May 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Computers and the Commons (May 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Z80 Text Compactor (May 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Word-wrapping (May 84)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
News	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Printout	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Club Call	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PROCopinion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Book Page	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Getting More From The 64	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Going FORTH Again	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Languages in Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Learning FORTH	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Problem Page	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easycode	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. How do you rate our hardware reviews, in general?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. How do you rate our software reviews, in general?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4

6. We cover a wide range of topics in the magazine. If you think we should pay more or less attention to any of the following, or if you think we've got the balance right, please indicate below.

	More wanted	Less wanted	All right now
Educational features	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Programming features	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hardware features	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Games software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Applications software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equipment reviews	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Software reviews	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Book reviews	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
News	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. We regularly publish listings of programs for readers to type in. How do make use of these?

Do you type them in exactly as listed? ☐

Do you make small changes to suit you? ☐

Do you rewrite completely for other machines? ☐

READING HABITS

8. Do you consider yourself to be a regular reader of Computing Today?

Yes ☐ No ☐

9. If Yes, how long have you been reading the magazine?

Less than six months ☐

Six months to a year ☐

One to two years ☐

More than two years ☐

10. How many copies of the magazine have you bought in the past year?

.....

11. If you have been reading the last 12 issues of the magazine, do you think we've

Improved ☐ Got worse ☐ Stayed the same ☐

12. How long do you keep copies of the magazine?

One month ☐ Three months ☐

12 months ☐ Longer ☐

13. If you are not a subscriber do you buy your copy

At a local newsagent ☐

On your way to work, at a station etc ☐

Have it delivered by a newsagent ☐

Pick it up when you see it ☐

14. How many other people read your copy?

COMPUTERS AND YOU

HOME

15. Do you own a home computer?

Yes ☐ No ☐

16. If yes, please indicate which make it is.

.....

17. How much do you intend to spend on computers this year?

Up to £100 <input type="checkbox"/>	£400 to £800 <input type="checkbox"/>
£100 to £200 <input type="checkbox"/>	£800 to £1500 <input type="checkbox"/>
£200 to £400 <input type="checkbox"/>	More than £1500 <input type="checkbox"/>

18. How much do you plan to spend on peripherals this year?

Up to £100 <input type="checkbox"/>	£400 to £800 <input type="checkbox"/>
£100 to £200 <input type="checkbox"/>	£800 to £1500 <input type="checkbox"/>
£200 to £400 <input type="checkbox"/>	More than £1500 <input type="checkbox"/>

19. What type of peripherals are you planning to buy?

Memory <input type="checkbox"/>	Modem <input type="checkbox"/>
Printer <input type="checkbox"/>	Prestel/Teletext <input type="checkbox"/>
Discs <input type="checkbox"/>	Monitor <input type="checkbox"/>
Graphics unit <input type="checkbox"/>	

20. Which of the following areas of activity do you use your personal computer for?

Home use/games <input type="checkbox"/>	Business <input type="checkbox"/>
Scientific <input type="checkbox"/>	Educational <input type="checkbox"/>

Please indicate the main use only.

21. Do you belong to a computer club?

Yes ☐ No ☐

WORK

22. Do you use a computer in your job?

Yes ☐ No ☐

What is your job title?

.....

23. Do you make purchasing decisions on equipment and software?

Yes ☐ No ☐

24. If yes, what is your annual budget?

.....

ADVERTISING AWARENESS

25. Do you read the advertisements in Computing Today?

Yes ☐ No ☐

26. Have you ever ordered any of the following goods from an advertiser in Computing Today?

Computer <input type="checkbox"/>	Modem <input type="checkbox"/>
Memory <input type="checkbox"/>	Printer <input type="checkbox"/>
Disc drive <input type="checkbox"/>	Business software <input type="checkbox"/>
Discs <input type="checkbox"/>	Games software <input type="checkbox"/>
Graphics unit <input type="checkbox"/>	Systems software <input type="checkbox"/>
Other (please specify) <input type="checkbox"/>	

.....

27. Any comments on the service you received?

PERSONAL PROFILE

The questions in this section are of a personal nature. Although we do not want your name or address, please feel free to ignore any question you would prefer not to answer.

28. How old are you?

15 or under <input type="checkbox"/>	46 to 55 <input type="checkbox"/>
16 to 25 <input type="checkbox"/>	56 to 65 <input type="checkbox"/>
26 to 35 <input type="checkbox"/>	66 and over <input type="checkbox"/>
36 to 45 <input type="checkbox"/>	

29. What sex are you?

Male ☐

Female ☐

30 What is your marital status?

Single ☐

Married ☐

31. Do you have any children?

Yes ☐

No ☐

32. Employment

At school ☐

At sixth form or technical college ☐

Student in higher education ☐

Employed ☐

Self-employed ☐

Unemployed ☐

Retired ☐

33. If employed or self-employed please indicate your earnings.

Under £4500 per annum ☐

£4500 to £6500 ☐

£6500 to £9500 ☐

£9500 to £14000 ☐

Over £14000 ☐

34. Do you hold a credit card?

Yes ☐

No ☐

35. Education. Please tick in the first column the standard of education you have already reached, and in the second column if you are still studying for a qualification (full or part time).

No formal qualifications

CSE ☐

O level ☐

A level/Scottish Higher/IB ☐

ONC ☐

HNC ☐

Bachelor's degree ☐

Higher degree ☐

36. Does any part of your course involve computing?

Yes ☐

No ☐

37. Do you read a newspaper? If so, indicate which one.

Times ☐

Guardian ☐

Telegraph ☐

Daily Mail ☐

Daily Express ☐

Daily Star ☐

Sun ☐

Daily Mirror ☐

Sunday Times ☐

Observer ☐

Mail on Sunday ☐

Sunday Express ☐

Other ☐

THE COMPETITION

38. Listed below are some of our competitors. Please indicate roughly how often you read them, and how they compare to Computing Today. If you don't read the magazine, leave all the boxes blank.

	Regularly	Occasionally	Poor	Fair	About equal	Better	Much better		Regularly	Occasionally	Poor	Fair	About equal	Better	Much better
Personal Computer World	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sinclair Programs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Practical Computing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sinclair Projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MicroDecision	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Commodore Computing International	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Your Computer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Computer Answers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electronics and Computing Monthly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Computer Choice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Computer and Video Games	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Byte	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What Micro?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Datalink	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Which Micro and Software Review	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MicroScope	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BBC Micro User	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	80 Micro	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Commodore User	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Your Spectrum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dragon User	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Computing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electron User	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Computer Weekly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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EXTENDING THE 64'S BASIC

Tony Cross

How often have you wished "Why isn't that command in the BASIC?" — especially on the Commodore 64 where the graphics and sound are all controlled by POKEs. Here's the answer to your problems: write your own keywords!

I'm sure that everybody knows by now that although the Commodore 64's sound and graphics features are fairly advanced, its BASIC is... well... fairly backward. My wife summed it up very nicely when she said that it sounded rather like fitting propellers to Concorde!

To compensate for this weakness, many enterprising software houses have started producing 'Commodore 64 BASIC extensions'. These are either tapes or cartridges which, when loaded, add varying numbers of new command keywords to the existing CBM BASIC. Now these ready-made 'bolt on BASICs' are fine: certainly the two or three that I have seen perform very well indeed. The problem with all of them is that you get the extra commands that the software author **thought** you wanted — and not necessarily the ones that you really did want. You see, as your programming tastes and skills change, the way you use BASIC also changes. So what you really need is a version of BASIC that can change with you.

This idea of an 'extendable' rather than a simply 'extended' BASIC forms the main subject of this series of articles. In it I will be showing you not only how you can add your own command keywords to the existing CBM BASIC, but I'll also be delving deep into the BASIC ROM to reveal and explain all the really useful routines. To complete the picture I will also be looking at the way the BASIC text and variables are stored and manipulated, and at the way the floating point maths routines work.

Even if you are not interested in adding your own keywords, this series will give you an insight into how and why CBM BASIC works, and that alone should help you to use the language more effectively.

BASIC BASIC

Before we can begin to think about adding to our keywords, we need to take a look at the way BASIC deals with the existing ones. So let's start this month by looking at how BASIC keywords are stored and interpreted.

The BASIC ROM contains many separate routines, but they are grouped together into two major systems, the Editor and the Interpreter. The Editor controls the entry of programs, both direct commands (with no line number) and numbered program lines. Whenever a user program is not running, the Editor is in control of the machine. The Interpreter, on the other hand, controls the running of programs, again both direct commands and numbered programs. The Interpreter is invoked whenever you type the command RUN, and it remains in control until either the program finishes, or until the STOP key is pressed.

Looking at the way that each of these systems is used, you can see that we want the Interpreter to run as fast as possible, in order to speed up the execution time. On the other hand, we can allow the Editor to run fairly slowly, because it only has to deal with the human user — and we're not very fast at the best of times! Obviously, then, we want to transfer as much work as possible

from the Interpreter to the Editor. And the task which takes up the most time is the checking which must be done to see if the current line contains a keyword. Briefly, this involves comparing each word in the current line against a table of BASIC keywords called the 'reserved words list'. There are more than 70 keywords in this table and the Interpreter would be extremely slow if it had to do all the checking.

WORKING THE EDITOR HARDER!

So, what is needed is some way of transferring this work to the Editor, where we can afford the time taken to check each line for keywords. This has been achieved by partly decoding the keywords as they are entered into the Editor. Each keyword, regardless of its length, is converted to a single byte value called a 'token'. The token is stored in memory in place of the much longer keyword. The value of the token is chosen so that it can be used by the Interpreter as an index into a table of addresses. This table, called the 'routine address list', contains the start address for each keyword routine.

The tokens are generated by a special routine which is called whenever the Return key is pressed (ie whenever a line has been entered, either for a direct command or a numbered line). It works by comparing each word in the input buffer with the keywords in the reserved words list. If a match is found, the position of the keyword in the list is used as the value of the token. In addition, to distinguish the tokens from the other characters in the line, the high bit of tokens is always set to 1.

For example, if a word in the input buffer matches the fifth word in the reserved words list, then the token value would be \$85. (\$85 is the digit 5 with its high bit set. This is actually the token for INPUT).

All the other characters in the input buffer are stored in memory exactly as they are typed, in standard ASCII format. (See Table 1 for a list of the BASIC tokens and Table 2 for a copy of the ASCII character set).

Now let's have a look at the way the BASIC program lines, tokens and all, are stored in memory. The best way to illustrate this is with a simple example, so have a look at this:

```
10 PRINT "FRED"
```

This line of code would be stored in RAM as follows:

```
0801 0E 08 0A 00 99 20 22 46 52 45 44 22 00
```

(Note — these are all hex values.)

At first sight this listing is pretty meaningless, but the following explanations should make it clearer. The '0801' at the start of the listing is the address, in hex, where the first byte of the line is stored. (All BASIC programs start at address \$0801).

The next two bytes '0E 08' can be ignored for the moment — I'll come back to them later.

TABLE 1

A list of the existing BASIC token values.

Hex token value	Keyword name	Hex token value	Keyword name
80	END	A7	THEN
81	FOR	A8	NOT
82	NEXT	A9	STEP
83	DATA	AA	+
84	INPUT#	AB	-
85	INPUT	AC	*
86	DIM	AD	/
87	READ	AE	↑
88	LET	AF	AND
89	GOTO	B0	OR
8A	RUN	B1	>
8B	IF	B2	=
8C	RESTORE	B3	<
8D	GOSUB	B4	SGN
8E	RETURN	B5	INT
8F	REM	B6	ABS
90	STOP	B7	USR
91	ON	B8	FRE
92	WAIT	B9	POS
93	LOAD	BA	SQR
94	SAVE	BB	RND
95	VERIFY	BC	LOG
96	DEF	BD	EXP
97	POKE	BE	COS
98	PRINT#	BF	SIN
99	PRINT	C0	TAN
9A	CONT	C1	ATN
9B	LIST	C2	PEEK
9C	CLR	C3	LEN
9D	CMD	C4	STR\$
9E	SYS	C5	VAL
9F	OPEN		
A0	CLOSE	C7	CHR\$
A1	GET	C8	LEFT\$
A2	NEW	C9	RIGHT\$
A3	TAB(CA	MID\$
A4	TO	CB to FE	Unused at present
A5	FN		
A6	SPC(FF	PI

TABLE 2

The ASCII character set (the part used by CBM BASIC).

Hex code	Character	Hex code	Character
00 to 1F	Unused	40	@
20	Space	41	A
21	!	42	B
22	"	43	C
23	#	44	D
24	\$	45	E
25	%	46	F
26	&	47	G
27	'	48	H
28	(49	I
29)	4A	J
2A	*	4B	K
2B	+	4C	L
2C	,	4D	M
2D	-	4E	N
		4F	O
2F	/	50	P
30	0	51	Q
31	1	52	R
32	2	53	S
33	3	54	T
34	4	55	U
35	5	56	V
36	6	57	W
37	7	58	X
38	8	59	Y
39	9	5A	Z
3A	:	5B	[
3B	;		
3C	<		
3D	=	5E	↓
3E	>	5F	↑
3F	?	60 to 7F	Unused

The third and fourth bytes, '0A 00', are the line number, in standard low/high format. (000A hex is the same as 10 decimal).

The next byte, '99', is the token for the PRINT keyword. (Notice that this is the only character on the line with its high bit set).

The next seven bytes, '20 22 46 52 45 44 22', are the ASCII characters for "FRED" (preceded by a space).

The final byte, '00', indicates that this is the end of the line. All lines of BASIC end with a null (00) byte.

INTERPRETING BASIC

I said earlier that tokenised keywords help to speed up the Interpreter, so now let's have a look at how they are dealt with. When the Interpreter 'scans' a program line, any character with its high bit set is assumed to be a token. (Unless it's in a quoted string). When the Interpreter encounters a token, it removes the high bit (it only indicates that this is a token and serves no other purpose) and uses the rest of the token as an index into the routine address list. Control is then passed to the keyword routine whose address was found at this location.

The keyword routine performs the actions required of the particular keyword and can, if necessary, read parameters from the rest of the program line. In the previous example, for instance, the PRINT keyword routine will read the string "FRED" from the program line and print it. (I will be showing you how to do this in later articles). When the keyword routine has finished, it returns control to the Interpreter which then begins scanning the next line (or the rest of this one if there is more to come).

I'm sure that you can now see that the Interpreter spends much less time executing tokens than it would if it had to decode the whole keyword. In addition, the single byte tokens occupy less space than the keywords, thus giving us a saving in memory!

LARGER PROGRAMS

In the previous example we saw how a single line of BASIC is stored. Now we'll increase the complexity slightly and look at how several lines of code are stored.

We have already established that each line of BASIC ends with a null. It should be no surprise, then, to find that the next line of code begins on the byte following this null, and that this process is repeated for every line in the program. Now this system is very convenient for the Interpreter, because it scans the lines a character at a time and the null is a clear indication of where one line ends and another begins. However, it makes life very difficult for the Editor, because it treats lines as complete entities rather than as individual characters.

For example, consider what happens when the Editor needs to insert a new line (say, line 25) in between two existing lines (say, lines 20 and 30). The Editor needs to know where line 20 ends and line 30 begins so that it can open up a gap for the new line 25. Since there are null bytes at places other than the ends of lines (in line numbers for example) there is no way that the Editor can hope to find this point. Clearly, some additional method of indicating the beginning of lines is needed.



This is where the two 'extra' bytes (0E 08) in the previous example come in. These two bytes are pointers and they point to the address of the start of the next line (low byte specified first). So, looking back at the previous example, the next line will begin at address \$080E. Let's expand this example so that we can see the use of line pointers more clearly:

```
10 PRINT "FRED"
20 LET A=34*2
30 GOTO 10
```

This program will be stored in memory as follows:

```
0800 00 0E 08 0A 00 99 20 22 46 52 45 44 22 00 1B 08
0810 14 00 88 20 41 B2 33 34 AC 32 00 24 08 1E 00 89
0820 20 31 30 00 00 00
```

To make the line pointers more obvious I have marked them with an underline. Check that you can start at address \$0801 and follow the line pointers through the program.

There are one or two things which you may have noticed as you did this. First, I said earlier that BASIC programs start at address \$0801, and yet I have started the listing above at address \$0800. Well, the truth of the matter is that BASIC programs actually start at address \$0800 — but this first byte is always null, so effectively, programs do start at address \$0801.

Second, the last three bytes in the program are all null. Now, we know that the first of these nulls indicates the end of line 30, and so the next two nulls are where we would expect to find the line pointer for the next line. Obviously, there can never be a line pointer to address \$0000, and so two nulls in the line pointer bytes are used to indicate the end of the program.

Third, even the '=' and '*' signs have been tokenised in line 20. Although this doesn't save any memory space it does make them execute much faster. (I will be showing you how tokenised expressions like this are dealt with in a later article).

This method of storing BASIC text with pointers in the next line is a very common data structure. It is called a LINKED LIST because each item in the list (each line in this case) is linked to the next by a pointer. Figure 1 shows a diagram of this linked list principle.

MULTI-STATEMENT LINES

Up to now I have assumed that each program line only contains one statement, so now let's have a look at how multi-statement lines are handled. The different statements on multi-statement lines are separated by the colon character (:), like the following example:

```
10 PRINT "FR:ED" : LET A=34*2 : GOTO 10
```

This program will be stored in memory as follows:

```
0800 00 20 08 0A 00 99 20 22 46 52 3A 45 44 22 20 3A
0810 20 88 20 41 B2 33 34 AC 32 20 3A 20 89 31 30 00
0820 00 00
```

The main thing that I want you to notice from this listing is that the colons which separate the statements have not been tokenised. To illustrate this, I have included an extra colon in the PRINT string, and you can see that all the colons in the program are the same (\$3A). Fortunately, the Interpreter can tell the difference between a printable colon and a statement separator! It does this by assuming that colons within quoted strings are ordinary printable colons, and that colons anywhere else on the line are statement separators. When the Interpreter encounters a statement-separating colon it acts as though an end of line (null) had been reached, except that it doesn't look for a line pointer or a line number before the next statement.

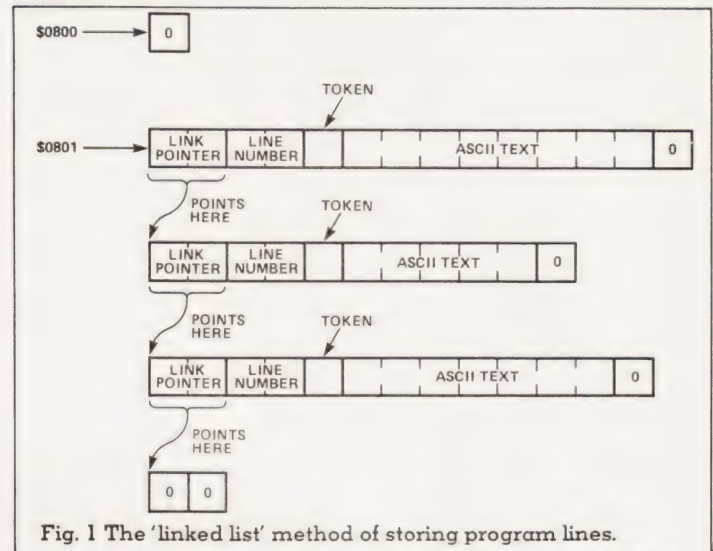


Fig. 1 The 'linked list' method of storing program lines.

LISTING TOKENISED PROGRAMS

Converting keywords to tokens is all very well, but what happens when you want to LIST the program? Obviously, we don't want the token characters to be printed, we want the actual keywords. So, the LIST routine will have convert the tokens back into keywords again.

Actually this is a fairly simple process because the token can be used as an index back into the reserved words list. This table contains printable characters for all the keywords, the only problem being that there is no way of knowing in advance how long each keyword is. To overcome this problem, the high bit of the last byte of each keyword in the table has been set to 1.

So, all the LIST routine needs to do is to use the token as an index into the reserved words list, and then keep on printing characters until it finds one with the high bit set. When it finds this character it must strip off the high bit, print the word and then return to printing the rest of the line.

NEW TOKENISED KEYWORDS

Having seen how the existing keywords are handled we are now in a position to look at how new keywords can be added. In fact there are several ways of adding new keywords to Commodore BASIC, some more efficient than others. The system that I have developed 'copies' the existing BASIC as much as possible by using tokens for the new keywords. In next month's article I will be explaining how this 'Extendable BASIC System' works and how you can use it to add your own keywords.





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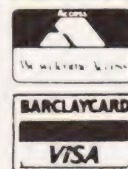
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THE ATMOS STRIKES BACK

Samuel Watts

Repackaged, reROMed and relaunched, the new Atmos is the latest offering from Oric. Is it an exciting new machine, or just a sheep in wolf's clothing?

It is no secret that the Oric Atmos is essentially a modified and enhanced Oric 1 in a smart new case. The real questions to be answered are how great an improvement is the new version, does it really overcome all the bugs present in Oric's initial offering and how serious a challenger is it to micros in its price bracket?

INSPECTING THE PACKAGE

Starting at the top of the list, even the most obvious aspects of the repackaging constitute worthwhile improvements. There is no gainsaying the fact that with its clean black, white and red colours, the Atmos is an extremely attractive looking machine. But more importantly the new keyboard is satisfying and pleasant to use. It follows the layout of the Oric 1 but has 'proper' typewriter style keys — with 4 mm travel for the technically minded! The layout itself is a perfectly sensible and acceptable arrangement — even the arrow keys (positioned on the very bottom line at either side of the space bar) are in a convenient place for most applications, although seasoned computer game players may find absence of the familiar 'cross' layout for the cursor keys confusing.

Along the rear of the case are a range of sockets that are used to connect the Atmos to the outside world. Power is supplied through a separate unit with a built-in 13 amp plug and fairly long cable. Video output is provided as a UHF signal that will drive a standard TV set or as an RGB signal for a colour monitor. The fact that the Atmos can drive a colour monitor without any extra electronics may give it an advantage in some appli-

cations, although as its display is limited to 40 characters per line a standard TV set gives an adequate display. A connector for a Centronics-compatible printer is another feature which may give the Atmos an edge over its competitors — a good keyboard and a printer interface as standard is the minimum requirement for a low-cost word processing system.

A 7-pin DIN socket is used to connect a standard cassette recorder for program and data storage. One problem is that the cassette lead supplied with the Atmos is terminated by a 3-pin DIN socket, apparently on the grounds that most cassette recorders have such a connection. However, in my experience most low cost recorders have miniature jack sockets for earphone and microphone rather than a DIN connector. The use of a 3-pin DIN connec-

tor also means that the cassette's remote control (if any) isn't used, even though the Atmos includes a relay and the software to start and stop the tape automatically. All this suggests that one of the first things to do is make or buy a new cassette lead for your Atmos!

The final connector is an expansion interface used to connect such things as the Oric 3" disc drives. One interesting feature is that the manual (see later) goes to great lengths to describe how to interface custom devices to the Atmos using the expansion interface — a trend that other computer manufacturers should follow.

INSIDE THE BOX

Taking the Atmos apart — something that I can't encourage the reader to do for himself as it invalidates the

warranty on the machine concerned — reveals that the internal layout of the Atmos is virtually identical to that of the Oric 1 — indeed, as our photo reveals the Atmos we were supplied had sufficient of an identity crisis to believe that it was an "Oric 1, issue 4"!!

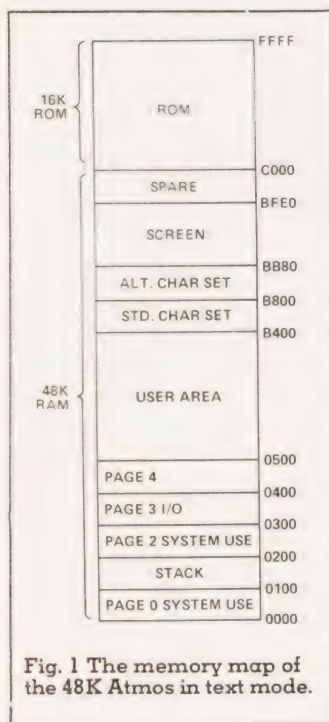
Comparing the components and PCB layout with a fairly old Oric 1 reveals no obvious circuit changes — something that will make Oric 1 owners breathe a sigh of relief. The only noticeable change is the use of a single ROM in the Atmos compared to a pair of EPROMs in the Oric 1. This is a reflection of the fact that most of the newness of the Atmos is to be found in its software and this is described later.

HARD FACTS

As far as hardware is concerned the Atmos is a straightforward 6502 design. The only unusual chip to be found is the custom-built ULA that seems to turn up so often in electronics these days. In this case the purpose of the ULA is to generate the video display. There seems to be no way to 'tinker' with the setting up of the ULA and so the Atmos is restricted to its two standard modes — text/low-res and hi-res graphics (unlike the Dragon, say, that seems to have more *undiscovered* display modes than the ones it admits to!).

The other 'big chips' in the system are a 6522 VIA that pro-





vides the keyboard, Centronics printer interface and controls the sound generator chip; and the sound generator chip AY-3-8192 itself. The fact that the VIA has three on-board timers, one of which isn't designated for system use makes it surprising that Atmos BASIC doesn't have a timer function or command. However, it is not difficult to produce one using DEEK and DOKE (16-bit versions of PEEK and POKE).

The amazing AY-3-8912 sound generator chip is used to good effect in the Atmos, which can claim to be one of the

loudest computers on the market! Although the sound specification on the Atmos is superficially similar to the BBC Micro, that is, three tone channels and one noise channel, it is interesting to notice the different ways that it is achieved. The BBC Micro uses a fairly simple sound effects chip and a great deal of software to make it into a superb sound effects system. The Atmos uses a complex sound effects chip and a very simple software driver. The difference from the user's point of view is that the software-based sound generator is more flexible but of course the hardware intensive system is simpler. The final components of the Atmos are eight 64K dynamic RAM chips and the 16K ROM that holds the system routines and Atmos BASIC.

WORDS ABOUT WORDS

Before we leave the subject of the new packaging it is certainly worthwhile taking a good look at the new Atmos Manual. This is a hefty volume of around 300 pages. The main part of the manual is a guide to the action of each of the BASIC keywords along with one or two short examples. What is remarkable about this new manual is that it includes the sort of information that normally takes a great deal of experimentation to discover. For example, for assembly language programmers it includes details of the I/O routines

that Oric have had to add to the core of Microsoft BASIC to produce Atmos BASIC. There is a full list of all memory locations used to hold system values and constants. For the hardware enthusiast there is plenty of help on how to go about connecting special equipment using the expansion interface.

BEATING THE BUGS — ATMOS BASIC

Probably the main rationale for launching the Atmos as a micro with a new identity was to put as much emphasis as possible on the fact that it had got rid of the bugs in the Oric 1's ROM. For those readers who have not paid attention to the details of these bugs, suffice it to say that the STR\$ function no longer adds an odd control code to the front of its results, the TAB function now works, and the printer no longer adds spurious characters to listings etc.

Probably the most important omission rectified by the Atmos is achieved by the PRINT @ command. This allows the text cursor to be positioned at any point on the screen, and so not only provides a way of setting the position that data will be printed, it also allows control over where input will appear on the screen. For example, PRINT @x,y:INPUT A will move the text cursor to x,y and then allow the user to type the digits of the value of A. Previously this sort of input positioning had only been

possible by direct modification of the system variables using POKE. (It is worth mentioning that this older method of cursor position still seems to work on the Atmos.)

There has been some criticism that the Atmos's TAB function still doesn't work because it overwrites anything on the line that is being 'tabbed along' with blanks. However this is NOT a bug and in most versions of BASIC (eg ZX BASIC) this is exactly how the TAB function is supposed to work! (Matter of opinion: I say it is a bug! — Ed).

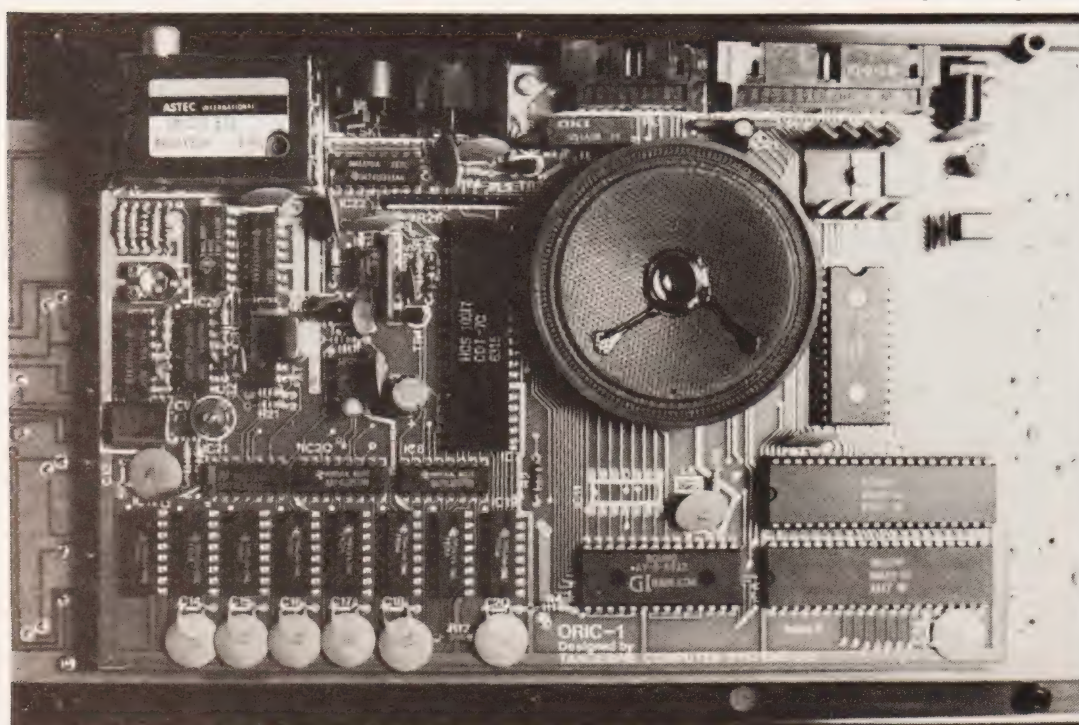
The only other brand new Atmos command is EDIT. All this command does is to list a line and then position the cursor at its start so that it can be edited. This is such a simple command it hardly seems worth mentioning as an addition to Atmos BASIC, but in practice it is extremely useful.

Apart from its own unique I/O commands, Atmos BASIC is a fairly standard variety of Microsoft BASIC. That is, it has IF... THEN... ELSE and REPEAT... UNTIL, but the only method it offers for forming modules is by the traditional BASIC keywords GOSUB and RETURN. The special I/O commands for handling the graphics and sound are generally easy to use, although if you are familiar with another computer it might take a little time to come to terms with the Atmos's set of commands. They are very logical but it just takes a little thinking about to decide what each one is for.

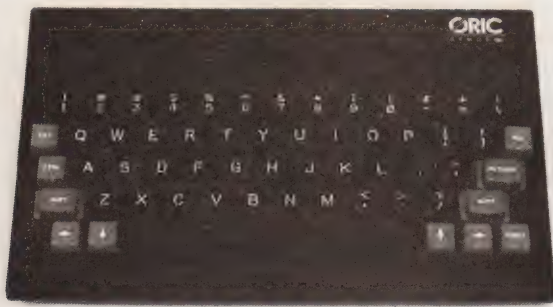
For example, 'PLOT x,y, string' will print a string of characters at x,y on the text screen in the same way as 'PRINT @x,y,string'. The question is, which instruction should you use when? The answer is that the PLOT command doesn't disturb the text cursor but PRINT @ does. The high resolution commands also take a little time to organise into a coherent set suitable for programming — but they are all there.

THE TAPE SYSTEM

One of the features of the Atmos that I was keen to test was its cassette filing system. While there has certainly been an improvement on the original Oric 1's performance, my own experience certainly suggests that the Atmos has not yet overcome all the problems. I have to admit to disliking cassette storage at the best of times — I've been spoilt by disc systems



Is it a bird, is it a plane? No, it's the Oric-1 Issue 4!



over too long a period and I am not prepared to come to my final conclusions about the Atmos until I've had a chance to test it with its disc drives. So we will all have to wait until the second part of the review which looks at "The Atmos for Applications" and covers its use in conjunction with its 3" drives and four-colour printer.

The Atmos claims to have improved error checking over the Oric 1 and certainly it did seem to generate more 'errors found' messages than the Oric 1! Most of these errors had no effect on the program loaded — in other words the errors must have been in the tape header or somewhere unimportant — but the fact that the error message appeared generated a sense of untrustworthiness. Additional commands have been added to enable entire arrays to be saved and there is also a non-destructive verify option to make sure that the data has been correctly saved. Even so, I had many of the troubles that I encountered when trying to load tapes on the Oric 1.

For example, I occasionally lost control of the machine in the middle of loading and often a program would have spurious lines appended on it. It is true that if a program loaded without an "errors found" message it was OK, but then most of the programs that loaded with "errors found" messages were also OK — very puzzling! My advice is to stick to the slower speed and to make multiple copies of programs you want to keep.

COMPATIBILITY

As part of my testing of the Atmos I spent quite a lot of time loading old Oric 1 programs to see if they still worked. This is also something that is important to those intending to purchase an Atmos — there is quite a lot of Oric software about and it's a shame not to take advantage of it. I chose as my source material *The Oric Book of Games*, a

collection of 21 full colour graphics games by Mike James, S.M. Gee and Kay Ewbank, published by Granada (which I just happened to have the cassette tapes for!). Eventually, with lots of patience (and some undeniable frustration) I did get every single program to load and having loaded them all ran properly without modification. As a result I can assure readers that software originally written for the Oric 1 does work on the Atmos. However, given that such software had to employ some crafty techniques to get round the Oric's bugs it cannot be regarded as being written in best Atmos BASIC. Hence it is all the more surprising that the programs worked without modification! (A new version of the book, written

and lower case characters and the familiar teletext block graphics characters. With both upper and lower case characters the Atmos is suitable for serious applications, but the 40-column screen is something of a limitation. However, the display is fairly clear even on a standard UHF TV set and this would not be the case with an 80-column display!

The Atmos can display eight different colours, using no more memory than for a black and white display, but there are restrictions. The colour is controlled by storing 'attribute codes' in memory locations that would otherwise be used to store character codes: ie serial attributes are used. An attribute code effects the colour of all the characters on the same line and to its right unless it is 'overridden' by another attribute code on the same line. So to display the word BLUE in blue and the word RED in red the screen would have to contain data as shown in Fig. 2.

Notice that the attribute codes take up a screen location that would otherwise hold a character. As attribute codes are displayed as blanks or spaces in the current back-

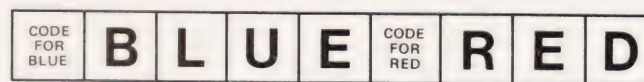


Fig. 2 Screen location contents to display the word BLUE in blue and RED in red.

using Atmos BASIC, is about to be published.)

GRAPHICS AND SOUND

The most important thing to say about the Atmos is that it uses a system of 'serial attribute' graphics based on the teletext system. This is also the feature that sets it apart from other computers in its price range. In its low resolution text and graphics mode the Atmos can display 27 lines of 40 characters. There are two character sets provided and as both are stored in RAM they are completely user-definable. They are initialised to the standard ASCII upper

ground colour, the two words 'BLUE' and 'RED' are displayed with a space between them, and there is no way to remove this space and still change the colour. Hence the main restriction of serial attributes is that whenever the colour changes there has to be a space. It is worth mentioning that this restriction doesn't seem to stop the teletext graphics artists employed by Ceefax, Oracle and Prestel from producing some excellent displays! Attribute codes can also produce double height and flashing characters.

The high resolution display is 240 by 200 pixels with two text lines at the bottom in the style of

the Apple II or the Atari. The display is easy to control using Atmos BASIC as long as you restrict yourself to two colours. Unfortunately the serial attributes method of controlling the colour has been extended to the high resolution mode and here it seems less natural. The trouble is that, just as in text mode, to change the colour of the pixels you have to store an attribute code into a screen memory location that would normally control six pixels on the screen. Once again an attribute effects all of the pixels to its right and on the same line. The screen location where it is stored is displayed as a row of six pixels in the background colour and hence high resolution graphics are subject to the same colour restrictions that apply to low resolution graphics.

After using serial attributes for some time I have to say that occasionally they actually make graphics easier. On balance, however, apart from limited text and low resolution graphics I would rather have a method of colour control that was not so restricting. Of course, I would also rather have the extra memory that the space-saving serial attribute method frees!

THE CONSUMER'S CHOICE

The real question is where does the Atmos fit into the current range of micro? It is undeniably a low-cost machine with the possibility of expansion to 3" disc and printer making it an attractive proposition. The unexpanded machine compares favourably with the Spectrum — it has a real keyboard and better sound although in my opinion its graphics are more difficult to use. Against the Electron its only real advantage is that it has a built-in printer port. The Atmos certainly fills a gap in the market but for real applications it has to be seen as one component in a system. This is what I intend to do more fully in the second part of my review when we will look at how the Atmos plus its peripherals can be expected to perform.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8
ATMOS	2.1	17.8	29.7	32.1	38.7	52.7	78.8	23.6
SPECTRUM	4.9	9.0	21.9	20.7	25.2	68.2	86.7	25.1
ATMOS (with keyboard inhibited)	1.6	14.0	23.3	25.1	30.4	41.3	61.6	18.5

Table 1. The results of Benchmark tests.

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NASPEN is the name of the Nascom/Lucas computer's word processor, and although produced in 1980, it remains a remarkably sturdy utility, and very "user-friendly" as the cliché goes. In 1980 computer memory was extremely expensive and the fact that NASPEN was only 2K in size was a distinct advantage — it left plenty of room for the text file. However, you cannot get everything into 2K of memory, and so NASPEN does not have a REPLACE command. Furthermore, the file will not accept graphic character codes, even though the Nascom keyboard produces them, and the number of words in a file cannot be automatically counted. It is all too easy to think of things that *could* be added to a word processor but the manufacturers cannot satisfy the requirements of every potential user, and so there comes a time when you may have to add a utility yourself.

There are really two sets of utilities in this package. The first set are the extensions to the NASPEN word processor, and will only work with that processor. I have taken into account that the user might have a modified version of NASPEN — it might, for example, have been moved to RAM at 1000 hex with a file starting at 2020 hex — and if this is the case the utilities will still work. The second set of utilities work independently of NASPEN, and thus may be used with different processors. All word processors must be instructed on the address of the printer driver and in a Nascom system it is commonly OE00 hex. To

UPGRADING YOUR WP

Richard Sargent

Our text, my brethren, concerns an add-on utility for the Nascom NASPEN, with some "Print-Time" routines which are applicable to other word processors.

run the utilities which operate at print-time, all that is necessary is to make sure that the character to be printed is sent to the routine NEWPRINT. From within NEWPRINT, the character (changed or unchanged) will eventually be sent to the real printer driver at OE00 hex or wherever.

THE NASPEN UPGRADE

The Nascom memory map decrees that NASPEN be in a ROM at B800 hex. (An assembler is at C000 hex and a BASIC at E000hex). It has workspace at 1000-1010F hex and at 0D00-0DFF hex. The text file begins at 1020 hex. The upgrade is placed in RAM at B000 hex. Since NASPEN is in ROM it cannot be altered, but fortunately this doesn't matter. NASPEN can be safely left at any time by pressing the Nascom reset button. All the extra utility routines return control to the NASPEN warm start at B806 hex.

The upgrade routines are:

- A global replace facility with counter.
 - Creation of three instant letter-headings.
 - Automatic insertion of "difficult" code 1B hex.
 - A word counter.
- and the print-time routines which are:
- Hexadecimal numbers converted to decimal.
 - Graphic symbols printed from simple on-screen code.

REPLACE

NASPEN's FIND command is used once, the string specified being the 'target' string. Allow NASPEN to find this string, then press RESET, followed by the monitor command EB000. The FIND command is now used again, but this time the string specified is the substitute string. Entering a reversed question mark (control/shift/z) is taken to mean that the target string should be removed without any replacement. Whether

this latest string is actually found is irrelevant.

The next step is to set the text cursor to the start of the file or the position where you wish the REPLACE to begin. RESET is pressed followed by EB003 and a global replace will occur automatically, starting at the cursor position and continuing until the end of the file is reached. The number of replacements (or removals) made will be recorded in HEX upon the screen and pressing any key will warm-start NASPEN.

HEADER

The monitor command EB006 will create a small NASPEN file, which, typically, could be a company logo or letter-head or any such heading that is used frequently. Such a heading might include complicated printer control commands which are difficult to remember and tedious to type in. As many as three such files may be created and this is how it is done.

NASPEN is cold-started, and a small amount of text is typed in, complete with printer controls and with all the line width information, page size and so on which NASPEN allows you to set up. Next the Nascom monitor is entered and the test and file information that you typed in is block-moved to one of three storage areas inside the utility program: C(opy) 1000 B21F 0100. The heading overwrites a NASPEN file, so the command EB006 is lethal! Instead of having three separate headings resting at B21F hex, B31F hex and B41F hex a single large heading could be stored at B21F hex, since the

```
B000 C3 E8 B0 C3 07 B4 C3 5B B0 C3 61 B0 C3 66 B0 C3
B010 28 B0 C3 2E B0 C3 95 B0 0C 1B 1A 10 18 10 20 10
B020 00 10 06 B8 2A 22 B0 E9 CD 3E B0 C3 24 B0 CD 33
B030 B0 18 F8 D5 3A 19 B0 57 3A 18 B0 5F 18 09 D5 3A
B040 18 B0 57 3A 19 B0 5F E5 C5 2A 1E B0 2B 23 7E FE
B050 FF CA 00 B6 B6 20 F6 7B 77 18 F2 CD 7B B0 C3 24
B060 B0 CD 73 B0 18 F8 CD 5B B0 18 F5 D5 E5 C5 21 1F
B070 B2 18 0E D5 E5 C5 21 1F B3 18 0A D5 E5 C5 21 1F
B080 B2 ED 5B 20 B0 01 20 00 ED B0 7E 12 23 13 FE FF
B090 CA 00 B6 18 F5 CD 9B B0 C3 24 B0 D5 E5 C5 F5 D0
B0A0 E5 2A 1C B0 5E 23 5B DD 21 99 B5 DD 36 03 00 21
B0B0 00 00 13 1A FE FF CA FD B5 FE 05 2B 18 FE 20 38
B0C0 F1 FE 23 38 0D 3E 01 D0 B5 03 DD 77 03 7B E3 23
B0D0 18 0E AF 19 F2 11 A0 B0 ED 53 29 0C CB 3C B0 1D
B0E0 DF 66 CF C3 FD B5 00 00 21 05 0D 01 FF FF 3E 5F
B0F0 23 03 BE 20 FB ED 43 05 B1 03 11 A0 0C 21 06 0D ED
B100 ED B0 C3 24 B0 00 00 21 05 0D 01 FF FF 3E 5F 23
B110 03 BE 20 FB ED 43 05 B1 03 11 A0 0C 21 06 0D ED
B120 B0 2A 1C B0 5E 23 5B EB 22 1B B2 3E FF BE 23 20
B130 FE 23 19 B2 21 00 00 22 1D B2 2A 1B B2 22 17 B2
B140 DD 2A 17 B2 DD E5 D1 1A FE FF CA F0 B1 21 B0 0C
B150 BE 28 04 DD 23 18 ED 7E FE 5F 28 08 1A BE 23 13
B160 20 F1 18 F3 EB 22 17 B2 E5 0E 00 3A A0 0C FE
B170 1A 20 02 0E FF ED 5B 05 B1 2A E6 B0 ED 52 20 02
B180 0E B0 79 32 16 B2 ED 5B E6 B0 E1 B7 ED 52 E5 DD
B190 E1 2A 19 B2 D1 ED 52 D5 E5 44 4D 05 C5 E8 E5 DD
B1A0 E5 D1 2A 1A B2 FE B0 2B 06 FE FF 2B 1A 1B 0A E1
B1B0 E1 18 22 EB ED 5B 05 B1 19 EB D5 DD E1 E1 C3 B7
B1C0 ED 52 19 30 0A 0B EB 09 EB 09 05 ED B8 1B 02 ED
B1D0 B0 DD 22 17 B2 D1 ED 4B 05 B1 21 A0 0C 3A 16 B2
B1E0 FE FF 2B 02 ED B0 2A 1D B2 23 22 1D B2 C3 40 B1
B1F0 2A 1B B2 3E FF 23 BE 20 FC 22 19 B2 ED 5B 19 B2
B200 2A 1A B0 73 25 72 2A 1D B2 EF 0C DD 2A 20 20 00
B210 DF 66 CF C3 24 B0 01 3E 20 91 20 20 20 00 00 00
```

Listing 1. (Left) Hex dump of the four NASPEN-specific utilities.

Listing 2. (Above) Hex dump of the two "print-time" utilities.



SYMBOL
EXCHANGE

Fig. 1. The graphics printer utility in action.



Fig. 1. The graphics printer utility in action.

```

;NASPEN REVISITED -- INCORPORATING PRINT-TIME
B666 ;CONVERSION ROUTINES : R SARGENT 1983
B666 ;LISTING OF SECTIONS WHICH THE USER MAY WISH TO
B666 ;CHANGE -- REFER TO HEX DUMP FOR ENTIRE CODE
      ORG 0B000H
B000 LOAD 0B000H
B000
OD06 FBUF EQU 0D00H+6
OCB0 NFBUF EQU 0CBOH
OCA0 RBUF EQU 0CA0H
OFFF FSVM EQU OFFH
OOSF ENWD EQU SFH
OOSF
OOSF ;B ENTRY POINTS
B000 C3EBB0 JP GET_TARG
B003 C307B1 JP INJ_SUBI
B006 C35BB0 JP #HEAD1
B009 C361B0 JP #HEAD2
B00C C366B0 JP #HEAD3
B00F C32BB0 JP $FLIP
B012 C32EB0 JP $FLOP
B015 C395B0 JP $COUNT
B015
B019 OC SYM7 DB OCH ;User's choice
B019 IB SYMB DW IBH ;User's choice -- normally IBH
B01A 1A10 $EOF DB 101AH ;Standard end of file location
B01C 1B10 $CUR DW 101BH ;Standard cursor in text location
B01E 2010 $TFILE DW 1020H ;Standard start of file-TEXT
B020 0010 $PREFILE DW 1000H ;Standard start of file-RAM
B022 06B8 $WARM DW 0BB0H ;Standard warm start
B022
B022 ;PART A
B022 ;NASPEN SUPPORT ROUTINES
B022 ;NOT LISTED
B21F LIST I
B21F FIN3 EQU $
B21F
B21F IMAG1 DS 100H ;Space for
B31F IMAG2 DS 100H ;pre-written
B41F IMAG3 DS 100H ;letter headings etc
B41F ;End of Part A
B41F
B41F ;*****
B41F ;PART B
B41F ;GRAPHICS PRINTER, INCORPORATING BASE
B41F ;CONVERSION HEX TO DEC
B41F ;SET FOR EPSON RX80
B51F
B51F 3E3D PROCESS LD A,"=" ;The purpose of the routine PROCESS
                    ;is to print out the = sign
B524 CDA3B5 CALL PRINT ;and then take the 4 digit binary
B524 3A9FB5 LD A,(RAM1) ;number out of its 4 storage
B527 CB27 SLA A ;locations, convert it to a 16 bit
B529 CB27 SLA A ;binary number and then to a decimal
B52B CB27 SLA A ;number which gets printed out
B52D CB27 SLA A ;The time taken to do the conversion
B52F 67 LD M,A ;is in direct proportion to the size
B530 3AA0B5 LD A,(RAM2) ;of the HEX number
B530 ;etc etc The rest of the routine is
B599 LIST I ;long and irrelevant
B599 00 SW DB 0 ;Switch1 :if ON do numeric conversion
B59A 00 SW2 DB 0 ;Switch2 :if ON do graphic conversion
B59B 00 CC DB 0 ;Counter checking for 4 hex digits
B59C 00 TYPE DB 0
B59D 9FB5 STORE DW RAM1 ;Pointer into RAM1-RAM4 area
B59F 00 RAM1 DB 0 ;Hex digits stored here
B5A0 00 RAM2 DB 0
B5A1 00 RAM3 DB 0
B5A2 00 RAM4 DB 0
O00B SYM EQU OBH ; (downarrow)
O05C SYM2 EQU SCH ; (backslash)
O05C
B5A3 F5 PRINT PUSH AF ;PUT THE
B5A4 CD000E USER2 CAL OE00H ;ADDRESS OF YOUR
B5A7 F1 POP AF ;PRINTER DRIVER
B5A8 C9 RET ;HERE AS CD 11 hh
      B5AB
B5AB CDA3B5 CONT3
B5AC DDCB0046
B5B0 C2C3B5
B5B3 219FB5 EXITX
B5B6 229DB5
B5B9 AF
B5BA 3299B5
B5BD 329BB5
B5C0 C3FD85
B5C3 FE48 CONT2
B5C5 CA1FB5
B5CB FE68
B5CA CA1FB5
B5CD 4F
B5CE 3A9BB5
B5D1 FE04
B5D3 28DE
B5D5 7F
B5D6 2A9DB5
B5D9 FE30
B5DB 3808
B5DD FE3A
B5DF 3004
B5E1 DE30
B5E3 1B0A
B5E5 FE41 NOTNUM
B5E7 3BCA
B5E9 FE47
B5EB 30C6
B5ED DE37
B5EF 77 VALID
B5F0 23
B5F1 229DB5
B5FA DD3402
B5FF 1B04
B5F7
B5F9 DDCB00C6 SIG_EX
B5FD DDE1 BYE
B5FF F1
B600 C1 EXIT4
B601 E1
B602 D1
B603 C9
B603
B604 DD3401 INCBYTE
B607 1BF4
B607
B607
B607
B609 D5 NEWPRINT
B60A E5
B60B C5
B60C F5
B60D DDE5
B60F DD2199B5
B613 FE0B
B615 2BE2
B617 FE5C
B619 2BE9
B61B DDCB0146 CONT
B61F 2B8B
B621 FE30
B623 3808
B625 FE50
B627 3004
B629 C250 USER1
B62B 1B06
B62D FE20
B62F 38CC
B631 CBFF
B633 CDA3B5 EXITG
B636 1B05
B638
B638 ROUTEND
      B638
CALL PRINT ;Print a text character
BIT 0,(IX+0) ;Consider switch 1 and if ON
JP NZ CONT2 ;jump to CONT2
LD HL,RAM1 ;else
LD (STORE),HL ;reset some
XDR A ;pointers
LD (SW),A ;and switches
LD (CC),A ;and exit
JP BYE ;via BYE
CP "H" ;If H for HEX detected in the
JP Z PROCESS ;text then we are ready
CP "h" ;to process the HEX number
JP Z PROCESS ;into DECIMAL, but if H/h not
LD C,A ;read, then routine is still reading
LD A,(CC) ;the hex digits and unless 4 of
CP 4 ;them are found an exit will be made
JR Z EXITX ;and the conversion will not occur
LD A,C ;
LD (STORE),HL ;Get up pointer into RAM area
CP "0" ;and begin to check hex digits for
JR C NOTNUM ;validity
CR "9"+1 ;
JR NC NOTNUM ;
SUB 30H ;0-9 if valid change from ASCII
JR VALID ;to BINARY
CP "A" ;More checks
JR C EXITX ;Invalid digits will abort the
CP "F"+1 ;conversion
JR NC EXITX ;
SUB 37H ;A-F valid, so change ASCII to BINARY
LD (HL),A ;and store the binary
INC HL ;Advance pointer
LD (STORE),HL ;and store pointer
INC (IX+2) ;Increment hex-digit counter
JR BYE ;and exit
SET 0,(IX+0) ;Turn ON switch 1 to show
POP IX ;that a number conversion will
POP AF ;apply on the next few passes through
POP BC ;the NEWPRINT routine
POP HL ;BYE and EXIT4 are various
POP DE ;exits from this and other
RET ;routines
SET 0,(IX+1) ;Switch 2 is toggled to
JR BYE ;indicate that following text should
;be treated either as text if BIT0(IX+1)=0
;or should be converted to graphics if
;BIT0(IX+1)=1
PUSH DE ;----- THIS ADDRESS INTO YOUR
PUSH HL ;WORD PROCESSOR'S PRINTER VECTOR
PUSH BC ;(101EH for the Naspen)
PUSH AF
LD IX,SW ;Point IX to switch area
LD IX,SIG ;look for number-conversion code
JR Z SIG_EX ;Jump if detected, if not
CP SYM2 ;look for graphics-conversion code
JR Z INCBYE ;Jump if detected, if not
BIT 0,(IX+1) ;consider switch 2 and if it
IS OFF CONT3 ;is OFF continue, else we are
;considering
CP "0" ;graphics and if the text is in the
JR C QUITR ;range 30H to 4FH then convert to
CP "0"+1 ;RX80 graphic codes by adding 50H
JR NC QUITR ;For other printers a value other
ADD A,50H ;than 50H might be appropriate,
JR EXITG ;and get it printed via EXITG
CP 20H ;Wasn't 30H-4FH so is it a control
JR C BYE ;character 0-1FH ? If so don't print
SET 7,A ;else convert to graphic by adding 80H
CALL PRINT ;and print it
JR BYE ;and exit via BYE
LIST I
EQU $

```

Characters outside the range indicated above are converted directly to a graphic code by having their BIT 7 set.

Fig. 2 Epson RX 80 conversion table for the graphics routine.

the symbols involved, so any two may be used. EBOOF swaps them round throughout the whole file (FLIP), and EB012 swops them back again (FLOP), should that be required.

WORD COUNTER

The word count starts at the current cursor position, and continues until either a marker is found or the end of file is reached. A suitable marker is code 05 hex (a cross in a square). The monitor command EB015 starts the count, and the result is displayed in HEX on the screen. Pressing any key then returns control to NASPEN.

GRAPHICS PRINTER

This utility requires nothing as drastic as the pressing of the reset button, but it does require a suitable printer! The software that controls this routine is shown in the source listing and it may be modified to suit printers other than the Epson RX80, for which the routine has been written. The instruction to change would be the one at label USER1, address B629 hex, which converts a text code coming from the word processor into a graphic code going to the printer.

It works like this: when the printer software encounters a reversed slash symbol (\) it converts the characters following into graphic codes and prints them. When the next slash is encountered, everything reverts to normal. The slash thus has a toggle action. Figure 1 shows, first, what the screen displays, and second, what the printer prints out. Figure 2 shows the conversion table which applies to the Epson RX80. Remember,

though, to put your printer into graphics mode otherwise you will get some very peculiar results.

NUMBER BASE CONVERSION

This is another automatic routine, and it prints the decimal equivalent of any hexadecimal number. If a conversion is required, the hex number is preceded by a down arrow (\downarrow), code 0B hex. So \downarrow B012 hex prints AS B012 hex = 45074. Any number of conversions can be made, but unless the numbers are in a list, one beneath the other, the format of the lines will be spoilt, as extra characters are put into the line.

OTHER SYSTEMS

1) Put the address of your printer-driving software in at label USER2, location B5A5/B5A6 hex, and put the address of NEWPRINT into your word processor's printer vector.

2) If you are running a non-standard NASPEN change the addresses in locations B01A-B023 hex.

3) The code dealing with graphics-conversion has been deliberately placed at the end of the system, so that it may be extended. Try not to alter the addresses of `BYE` or `EXIT4` since those exits are used by other routines!

4) The entire system is given as two hex dumps. NASPEN users must use both, and save the code to tape as one entire block, while other word processor users should use the second hex dump only. If any reader wants a complete source listing badly, send us a stamped addressed A4 envelope.



In days gone by, falconry was the sport of gentlemen and kings — this noble and time-honoured tradition is not so prevalent in these technological times, and it is quite a pity, too. Just imagine the pride you'd feel standing in your own back yard while your very own hunting falcon swooped down upon unsuspecting dogs, cats and Ford Sierras.

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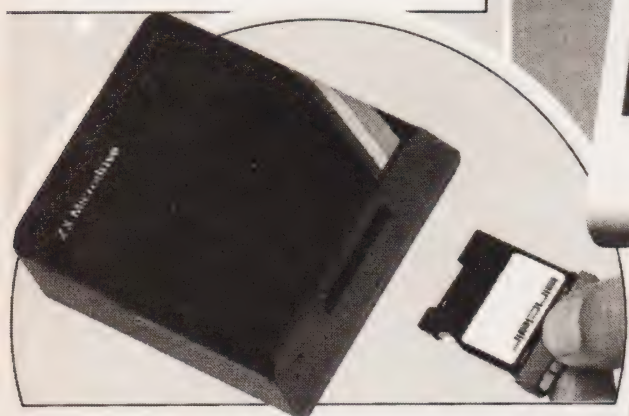
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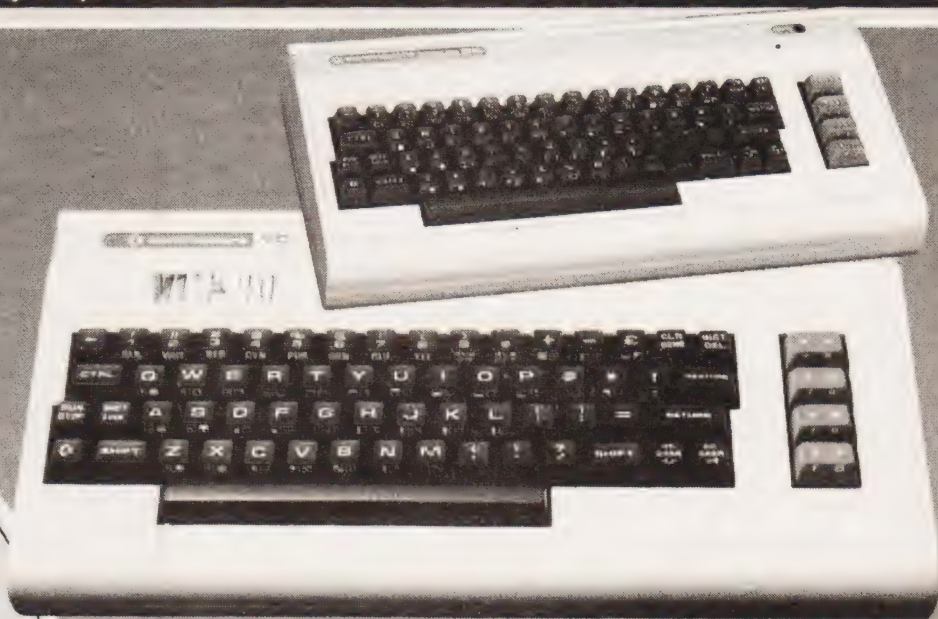
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YOUR QUESTIONS ANSWERED

I am interested in putting electronic mail on my micro — what sort of modem do I need to buy?

The short answer is that you need to ask the supplier of the electronic mail system you wish to subscribe to. Telecom Gold, for example, will advise you on 01-403 6777. However, here is some general advice.

The operation of a modem (or acoustic coupler — which doesn't have to be permanently installed next to one phone) is specified by four parameters:

- **Baud Rate.** A 300 baud modem transmits data at a rate of 300 bits per second, which translates to just over 30 characters of information or about five words. The faster the baud rate, the lower your telephone charges will be — although faster modems cost more money and may be more susceptible to occasional transmission errors. However, the determining factor is that computers at both ends of the telephone line must communicate at the same speed: it's no use transmitting at 1200 baud if the receiving machine is expecting 300. Some modems feature a switch to select different speeds, which is very useful for communicating with a variety of systems.

- **Duplex.** For electronic mail applications, where you will be both sending and receiving data, you need a **full-duplex** modem.

- **Originate/answer.** This is a confusing term, since it has nothing whatsoever to do with the ability of the modem either to send and receive data. An **originate only** modem is suitable for communicating with a large central mainframe computer such as Telecom Gold. If you wish to send documents direct from a microcomputer in your office to another microcomputer without going

through a central machine (of course you'll need special software), then both microcomputers require an **originate and answer** modem.

The latter features a two-position switch on the front of the device, and one office must have it switched to 'originate' and the other to 'answer'. By convention, the person who makes the call (ie dials the number) uses 'originate'. This, however, is pure convention — it would work perfectly well the other way round. The originate/answer label merely has to do with the means by which the connection is established — the originate device sends out a tone which the other acknowledges, and then data can be sent in either direction.

- **Autodial/auto-answer.** An **auto-dial** modem cuts out the need to physically dial the number of your other office or the central computer. It permits the computer to store all commonly used numbers, which can then be dialled up by the applications program.

Having an **auto-answer**

modem means that, providing the computer is switched on, an operator doesn't need to be present to receive the transmissions.

You say that an operating system is invisible to the end user. Does this mean it doesn't matter what operating system comes with my micro?

The operating system is a piece of software, a collection of routines, which looks after the internal operation of the computer, and which provides all the simple functions (such as getting a character from the keyboard) which will be needed by an applications package. So when your applications program is running (be it a word processor, database or whatever), the operating is 'invisible' (**transparent** is the conventional phrase) — even though the application depends heavily on it.

Some microcomputers, for example the Commodore range, use their own unique operating system, while other

machines go for proprietary operating systems available on several computers, and usually written by an independent software house. The advantage of the latter approach is that the hardware manufacturer ensures that more software packages will run on his machine (applications software either has to be written to run on one or more specific computers, or one or more specific operating systems).

If you're buying your first computer or application, then as you know, we recommend choosing the software first — which may then dictate your choice of hardware. What, however, if you are still left with a choice: a common example would be between CP/M-86 and MS-DOS running on the Sirius? Well, to be honest, providing you stick to the common operating systems it doesn't make a great deal of difference! The software authors may advise you that the package runs faster on one system than on another.

There are differences, of course, and these are most noticeable on the occasions when the user does deal directly with the operating system — ie when he isn't running an applications program. This is usually for **housekeeping** tasks such as preparing a new floppy disc (**formatting**), calling up the **directory** to see what files you have on a disc, **erasing** old or unwanted files, and making **backup** copies of files or whole discs. All operating systems feature these commands, though some are a good deal more logical and user-friendly in operation than others.

To repeat our advice: not a subject to lose sleep over, but if you get the chance to view more than one system, or talk to someone who knows them all intimately, so much the better.

YOUR QUESTIONS ANSWERED is our practical help page — in which we try to deal with the most common misunderstandings that arise when buying or using a business micro. If you have any queries either as a complete beginner or as an experienced user, please feel free to throw them at our panel of experts. We'll answer as many as we can each month. (We regret, however, that we can't guarantee to send personal answers). Please write to: **Your Questions Answered, Computing Today, No. 1 Golden Square, London W1R 3AB.**

ADVENTURE COMPETITION NO. 1

To be honest, we were a little disappointed by the response to this competition. We only received 20 entries: of those, two produced syntax errors when RUN, one wouldn't let us pick anything up (bit difficult to play, that one!), and most of the others used fairly standard plots, or else plots that were not consistent or not challenging enough.

Time being the scarce commodity it is, and not wishing to keep the entrants waiting weeks and weeks for a verdict, the following judging procedure was adopted. The game was loaded and played blind for about an hour to get the feel of it. Then we opened the solutions to see how the plot was resolved and whether the whole game had a satisfactory structure, was fair, and dealt with its scenario consistently.

Some people hadn't read our features on writing Adventures!

Eventually the choice came down to two games, both of which were practically in a publishable form, requiring only minor tidying up of screen formatting, spelling, and so on. We eventually decided on Stagefright because of the originality of the plot and the presentation.

Since half-a-dozen of the entries were deemed publishable if sufficient re-writing were done by the authors, following guidelines that we are sending them, we thought the joint authors of the winning entry should receive something extra, on top of the royalties from their game when published. So we are giving each of them a cash prize of £25.

Since the number of entries was so small, we feel that an honorary mention is due to

everyone who bothered to take part. Our two first prize winners are Andrew Pargeter and Stan Willey of Birmingham, who wrote Stagefright on the Spectrum. Dave Cockram of Merseyside came second with Quest for Eternity.

The other entrants were Paul Bunyee of Leicester; R. Patterson of Leicester; Bruce Goldie of Aberdeen; Arthur Woodworth and David Haslam of Stockport; P. Knibbs of Wakefield; S.A. Leek of Birmingham; C.B. Dunne of Harlow; S. Foster and I.D. Drennam of Edinburgh; Nick Tuckett of Wick, near Bristol; J.R. Bennet of Rotherham; R.G.A. Rigg of Daventry; Nick Bottomley, Neil Coldrick and Digby Gould of Derby; S. Gerard of Elstree; I.R. Sturgess of Portsmouth; John R.R. Clarke of Belfast; James Derbyshire of Billericay; D.C. Jordan and N.M. White of Orpington, and K.J. Delahoy of Edgware. Thank you all for taking part.

ADVENTURE COMPETITION NO. 2

The format of the second competition we ran last year was that of a multiple choice question paper. The catch was that picking an answer to a question also picked which question you should answer next. One wrong answer and off you went on a

totally incorrect route through the questions, maybe even answering some that you didn't have to.

The number of replies for this competition was a bit healthier, but out of the 454 entries we received, only 20 had the correct number written on the back of the envelope and of those, only 10 had obtained that number by traversing the correct route through the Adventure. Obviously our readership's deviousness quotient is low on the scale. There were no trick questions, but we did plan a rather nasty twist at the end for the unwary, which means 434 of you!

The correct answers were as follows:

Question 1. (B) Yes, most people thought that the phoenix lived in fire, but it is actually only born in flames. A trip to the nearest dictionary would have shown that the salamander is "a lizard-like animal supposed to live in fire".

Question 2. (E) The Z80 is the only microprocessor in the list that meets the requirements. Not a very taxing question, but then it wasn't on the sequence anyway.

Question 4. (B) The answer is 11, and shouldn't have caused any difficulty to readers since all the FORTH commands used in the question had been explained in the series Learning Forth.

Question 5. (A) Not a particularly taxing problem, either. It's a simple number base conversion, with 7248551 base 9 (geddit?) being equal to 3870712 base 10.

Question 6. (C) Another fairly easy one for mythology buffs. The modern version of the Greek information service is, of course, Oracle.

Question 7. (3) Another question not on the correct route, so its simplicity wasn't really us being kind to you. The only 16-bit machine in the list is the Apricot.

Question 9. (G) A bit of Boolean logic here. Working through the expression, 3 AND 5 is 011 AND 101 which is 001. Then 001 OR 110 (6) is 111, which is 7.

Question 11. (B) Yes, backing up a disc is an awful pun, but if you'd answered all the other questions correctly you wouldn't have got here anyway!

Question 12. (C) Well, the symbols on the wall are obviously examples of binary addition, so the correct reptile is the adder. Groan.

Question 14. (A) The language developed for programming by the US Department of Defence is Ada, named after Charles Babbage's assistant.

So if you managed to answer all the questions the route would have been through questions 1, 12, 4, 6, 14, 9, 5, 3 making the correct answer BCBCAGA. Room 3 contained the golden pentangle, and therein lay the Big Twist. With the artifacts being a triangle, square, pentangle and hexagon, most people thought "Ahh, 3, 4, 5, 6" and put five sides on the back of the envelope. Wrong! Only 20 people took to heart the Adventure-writing articles published in the two previous issues, specifically the part about misdirecting the player. Go back to the trusty dictionary and look up pentangle. It's a five-pointed star. A five-pointed star has 10 sides. Before you start screaming 'Unfair!', remember there was a big prize at stake and some people worked it out (I feel particularly sorry for the person who actually drew a pentangle on the envelope — and then wrote five next to it! Disqualified, I'm afraid!).

So of the 10 people eligible to win, the lucky one drawn out of the sophisticated CT randomizing device (a cardboard box) was Nathan Sidwell of Bristol. Congratulations to him on winning hardware to the value of £1000.



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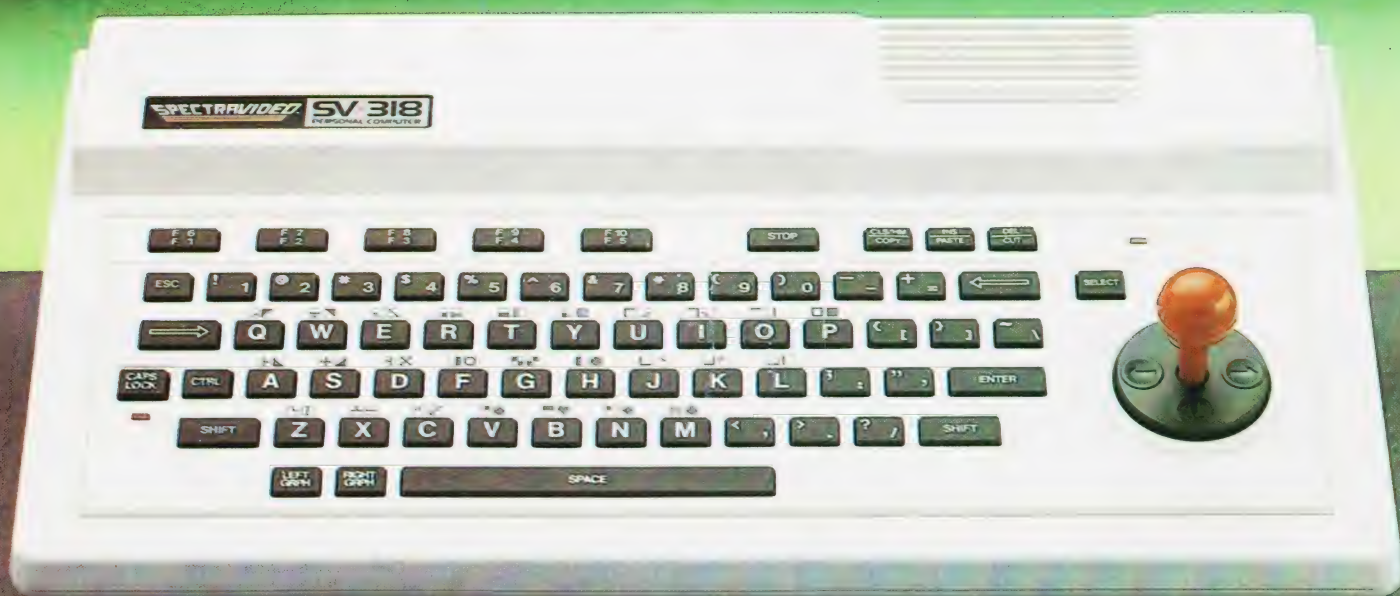
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CT/5/84

COMPUTERS AND THE COMMONS

Rex Malik

Big Brother would be watching you — if only he could find his glasses. We look at the technology-poor mess that constitutes the Mother of Parliaments.

We were this month going to be discussing politicians, the practice of politics, and all with particular reference to the use they make of microcomputers. Not whether they approve of them or not, or what they are doing to support either the industry or usage, but what use they make of them in running their own affairs.

Instead, we are going to be discussing computing and the practice of politics, a broader subject: what politicians could do with computers which could be in their and hopefully our interest if they had access to them in any realistic fashion. MPs using micros will, the editor willing, be discussed later in the year.

The reason for the delay is called Christmas, 1983 Christmas, which for politicians this last time around had both a real and a symbolic appeal.

STOCKING THE STOCKINGS

It is the latter which is of interest. I could give you the story in full boring detail, but let us instead settle for the short version which is just as useful. MPs get a £13,000 or so secretarial allowance, which they were till recently allowed to spend on running expenses, and the wages of secretaries and research assistants. This meant that if they bought any capital equipment, they had to pay for it themselves out of income and go through the same process as other people in business, claiming a capital allowance against tax and so on.

Last summer, it was decided as a result of complaints by MPs stretching back over a long period that they could make use

of some or indeed all of that annual sum to buy office equipment, including computers. So when Christmas came around, a substantial number of them were behaving like many of the rest of us. One informed source in Westminster did a quick calculation for me and then said that he thought adding MPs who already had equipment of some kind and those intending to buy something, about 10% of them would have computer power within a reasonable time.

Behaving like a lot of kids because it is Christmas? Even I have been buttonholed by one to discuss the merits of the PC over the Rainbow, or vice versa. Or should I be doing something else entirely?

There are, of course, a small group of MPs who already have systems, everything from Wang to a BBC B machine. But they are in a minority. What is more, a peculiar situation exists: those used to computing in their pre-MP life, mostly the '79 intake and onwards, are the most junior MPs. And life in the Commons is so organised that they will be the ones in the main with the most difficulty in making use of computer power. We shall come to the reason for that in a minute.

The reason then why I have chosen not to write about the handful of MPs who have computer power available is that they are as yet unrepresentative. However, possibly by the late summer enough should have experience for some operational conclusions to be drawn.

IN-CONCLUSION

I had better state straight away that I already doubt that the conclusions will tell us much about anything except the

practice of politics: MPs believe that they are in a unique business, and everything one sees indicates that they are right.

For it is not a question of how you run a small organisation — for the Commons including all its staff is less than 2000 people, even if you think that 650 of them skew the normal organisational distribution by having massive egos — it is rather that the Commons contains around 700 organisations, each fighting the others at least some of the time.

PROBLEMS

There is first that organisation we call Parliament, the system commanded by the Speaker through the Sergeant at Arms. There are next the various ministries which, though supposedly elsewhere, are represented by MPs who are Ministers; departments/ministries which have their own interests to put forward or defend and for whom part of the time some MPs have to do so. And there are the 650 MPs acting as representatives of their constituents, each running their own business much of the time against the desires and wishes of the ministries. You will note that I have not written anything about that other house, a few yards away across the central lobby, the House of Lords. They behave similarly to MPs in many respects, though there is the critical difference that they do not have constituents to whom they are theoretically responsible.

So when one writes about politicians using computers and associated information technology, we are really facing two separate problems. There is the problem which those 10% of MPs who are obtaining systems are concerned with, the representation

of their constituents, usually against the executive, and there is the collective problem. As the second is by far the most interesting, let us get the other out of the way first.

As an individual, an MP is really a 'small business'. Most will have support in the form of a secretary (did you know that a recent study showed that there is at least one MP who still writes most of his mail by hand?). Occasionally an MP will have a research assistant, sometimes the secretary will fill both roles. There are said to be MPs who have two secretaries plus a research assistant, one of those secretaries being in their constituency, but I have not met this mythological beast. However, the two-secretaries politician is not unusual, particularly when the constituency is, say, in the north, in Scotland, or in Wales.

WORKING HABITS

So what do they actually do, with or without secretarial assistance? We know much of that from studies mounted to try to work out what they are equivalent to, so that it could then be established what the going rate for the job was, and from a survey mounted by the Computer sub-committee of the Select Committee on House of Commons (Services). Summaries of material from a survey they had carried out of MPs and their work, habits, and thoughts were published just before Christmas.

"Each member adopts a different and individualistic approach to his work," stated the report. To which one can only say "You can say that again." The work they do is covered by the following broad categories. Constituency-related, much of which is fight-

ing ministries on behalf of their constituents, Chamber-related such as the raising of Parliamentary questions or PQs as they are known in the trade, government work when a member of a government, work connected with the select and standing committees they are members of, party political work, parliamentary party work, work concerned with their own special interests which means anything from putting forward the views of a body such as a trade union or an association (that an MP is sponsored by a trade union or, say, is the Parliamentary consultant to a body like the Police Federation, or is the master of the local fox hounds, is all usually well known) and international work such as representing the Friends of Abu Dhabi, delving into the EEC and such like.

An MP, states the study, receives on average 32 pieces of mail a day and sends out around 30: most of this is to or from constituents. You will also

be pleased to hear that most MPs are not backward at being forward: nearly 60% of them send items to the press.

They average about two hours a day on correspondence, and they generate speeches, articles and the like (though the survey points out that only 6% of members produce items of more than 50 sides of A4 a month, for which I suppose we all ought to be grateful). What we have here, then, seems to be a perfect case for some sort of word processing system.

DISORGANISED...

However, now it gets complicated. Remember that I wrote a few paragraphs back that one should think of them as small businesses? Well, they are all as independent, as stropky with each other, as a collection of small businesses are expected to be. So how are you to create systems to accommodate all that lot without complaint: how is it to be organ-

ised?

The answer to that is slowly and carefully. Which is precisely what is happening. Small scale experiments are being mounted, and the equivalent of multinational treaties are constantly being negotiated: for MPs can be a touchy lot. And this, of course, is one of the reasons why MPs are buying their own systems: most will have to if they are to get them before they retire or are evicted by the voters.

That is problem one. Problem two, however, is more severe. I also wrote that the '79 onwards intake, those with expertise, have the most difficult time applying what they may know to their life as an MP. The reason is this: the average dog is probably better officially housed than the average MP, at least in working hours. True, there is some quite good office accommodation in the Commons, but there is not much of it. And what there is comes through seniority (one cynical MP friend main-

tains that the reason he wanted to become a Minister was that he would have somewhere private to put his feet up and have a cup of coffee).

So the MPs most attuned to the 20th century are low men on the totem pole, as the phrase has it. Many MPs share offices with other MPs. Most, however, do not share them even with their secretaries: indeed many find that their secretaries are not even in the same building. And some, it seems, have given up altogether: their secretaries are in their constituencies.

... ORGANISATION

You might well say that what MPs need is to get collectively organised. You would be right. Unfortunately the present government, in the shape of the Prime Minister amongst others, sat on that. There were moves to give MPs proper offices in the late seventies, but Mrs Thatcher put a stop to them in the name of saving public expenditure. We shall get to this area in a minute.



We must for a paragraph or two more consider MPs as individual representatives.

As organised, computing even in terms of word processing and nothing else is not high on their list of priorities. The study done for the committee showed that the office question loomed largest; solve that and then you would get MPs worrying about what to do next. And what to do next would probably involve an improvement in the internal communications within Parliament. They are to have a new telephone exchange which should help, but that is only a part of the problem. What sort of business is it that . . . Well, let the report (5.18) tell it.

"In terms of face-to-face contact about 70% of those members whose secretaries are based in Westminster, see them at least once a day." Any comment from me would be superfluous.

And just in case you should think that what we are faced with here is solely the result of the intransigence of Ministers and Governments, it needs to be pointed out that much of the Palace of Westminster is old, and that supposing it were to be organised, that MPs all had offices, and that rationality prevailed (which I know is a large hope) there are also some other problems to be faced. You want to build a local area network? Then the dignity of the house will probably insist that the wiring be hidden. But what happens when you cannot lift up the flagstones? I did not make this up: the problem exists and has been cited as one of the difficulties faced.

NO PROGRESS

All this conspires to ensure that progress, whatever and whenever it occurs, will be slow. Meanwhile the report also notes a new problem arising. The Computer sub-committee recommend the field trial of a system based on distributed microcomputers (and promptly got themselves into trouble by short-listing only DEC, IBM, and Wang, all American-owned companies) which at the end of the third year — so we are probably talking about 1987/88 — should support between 15 and 25 members and their staff.

It is doubtful, however, if MPs will all be prepared to wait for the results of that. That 10% of

MPs who have or are about to take the plunge will do so probably independently. Which means that there is going to be a lack of compatibility. Indeed, that exists already. Some MPs told the sub-committee that whatever systems are implemented in the House, they should be compatible with the files that they have already built in their constituency offices. What the sub-committee were too tactful to write is that most of those few systems are incompatible with each other already.

COLLECTIVE RESPONSIBILITY

It is with relief that we must now consider MPs collectively. And that is a question of considerable public importance. It has been well noted that all MPs are in favour of a powerful Commons until they themselves become Ministers, when their enthusiasm becomes much muted. It would not be fair to castigate solely politicians in this country — this is a well-observed phenomenon in democratic countries in which the executive are selected from members of parliament.

Where they are not, as in the United States, they are prepared to do something about it. Thus the US Congress has long taken the view that members should be well served by whatever aids they require to enable them to tackle the executive. Literally hundreds of speeches have been made on this in Congress over the last 20 years, and then they have gone on to vote themselves the funds to enable something to be done (by contrast the vote for computing, both capital and running expenditure for both UK Houses of Parliament for the year 1983/84 is not much more than £1 million).

Something has been done, and it is not simply to give members proper offices and staff allowances with support from the best that technology can offer, but also to give members superb research facilities based on the Library of Congress. (And interestingly enough, it was a senior figure in that library, Robert Chartrand, who did more to educate members of Congress about what the computer makes possible than probably anyone else anywhere.)

The line taken by Congressmen is a simple one: they

TABLE 1: COMNET SERVICES

Voice

Committee coverage (close circuit feeds for recording of Proceedings — 100 discrete channels).
Off-air/cable FM distribution.
Intercom (point-to-point).

Video

House of Commons (HOC) Television (with Floor, English and French sound).

HOC internal TV services:

- news, information, familiarization, training.
- Demand video/archive retrieval.
- Full cable TV 'menu'.

Data

HOC Electronic Mail.

Internal information:

- daily events schedule, bulletin board.

Information retrieval:

- from Library, HOC services
- via gateways, from external data bases
- Telidon

Connection to/from common carrier networks, constituency offices.

Other

Provision for:

- security/alarms
- energy management

face an executive which can call on a massive bureaucracy and literally tens of thousands of computer systems. They obviously cannot face like with like in volume, but they can in skills. Hence Congress has access to hosts of computer models. So people might retort to our MPs: they have access to the Treasury model. Unfortunately, our MPs do not have the large administrative and research staffs which are the norm in Congress, staff who can devote days if not weeks to operate the systems in depth. Our MPs have in the main to rely on the staff of the Commons Library, around 100 people in all, to handle both conventional library enquiries and to access whatever computerised services are available.

OF SHARES AND SHEEP

The problem they face is one common to politics, but uncommon elsewhere. Politics is a profession full of figurative language and so are its records. What the policy is as discussed by Parliament — well, consider the following. It was a question asked by Mr Alfred Morris MP of

the Attorney General about the Lord Chief Justice.

" . . . if he will introduce legislation to divest the Lord Chief Justice of his responsibilities under specific deeds of trust: and if he will make a statement."

The Solicitor General: "No".

What, you may well ask, was that all about: what does it contribute to anything? And where are you going to file it? How about under Lord Chief Justice with a cross reference to duties, powers, responsibilities. If you did that, you would be wrong. What was at issue was for some weeks a cause celebre, whether or not the Trustees of a particular organisation had to be consulted before its residual owners could get their hands on the best part of a billion pounds or more. In other words this has to do with the possible flotation on the stock market of Reuters.

The problem with Parliament, and it is the same the world over, is that there is no vocabulary control. How can there be when the nature of the game is to make the point in the most telling way so that it will get as wide a coverage as possible and force the other side to do something even if only to respond in kind.

How about this: you are interested in sheep? Then what will you make of an entry which under that heading would include the name "Sir Geoffrey Howe"? Is Sir Geoffrey a sheep? I could go on in this vein and probably get myself locked up. In fact the reference is to an intervention by Dennis Healey when he referred to Sir Geoffrey Howe as looking as if he had been savaged by a dead sheep.

INDICES

As you can see there are problems with the recording of the proceedings of Parliament. MPs can talk in a kind of shorthand without vocal reference to the real events that are bothering them, but simply implicit reference. Everybody knows what they are talking about, and the indexer had better know too.

Nevertheless, almost everywhere people are putting up, or trying to put up, their version of Hansard. We do it here. It is called POLIS which stands for Parliamentary On Line Information System, and has been operational for just over three years. It is run by SCICON out of Milton Keynes where they have a computer centre with a large Univac system.

It was originally an index service only, a somewhat complex one which the staff of the Library of the House of Commons are said to swear by: the tools are said to be so powerful that it does not matter what the reference is, they can find the subject matter, and that covers not just the proceed-

ings in the Chamber, but also Acts of Parliament, EEC Legislation where it applies to this country, and most of the material as the result of the proceedings in the chamber.

For most of this stuff it is still an index service only: once you have found the reference you have to find the text and read the paper copy. However, since early December what happens in the main chamber has been available as a full text-on-screen service. You approach the material via your key words, those key words generate an index, and then you select the text you want to see from that index.

THE WHOLE TRUTH

What diligent seekers after truth really want, however, is coverage of those proceedings which usually take place upstairs — the reporting of committees — for that is where detailed cross examination takes place, where the executive comes into contact with the political skills of MPs. But everybody thinks that is a long way off. Yet it is the sort of material which might well show MPs at their best, trying to extract straight answers from the Civil Service, answers which will tell people something they might not otherwise be able to find out.

And the other restriction is that, as matters stand, most of the computerised search facilities are in the hands of library staff. MPs by past habit have long relied on that staff to do their digging and devilling for

them, and this has carried over into their use of computer systems. The notion that they might want to browse themselves has not yet occurred to more than a handful, and there is no pressure for it. The nature of the material too and the search methods, which are comprehensive, means that the skills could take some time to learn.

What I have described might lead you to suppose that British politicians have not, as yet, grasped the nature of information technology, and you would be right. That it could be of considerable help in their fight against the executive if properly organised is understood by few. Put against members of Congress in the USA, it would not be unfair to write that most of them do not, in this sense, inhabit even the same century.

COMNET

However, it is not the same throughout the rest of the world, particularly the English-speaking world. In Canada, which is a somewhat similar institution in terms of buildings, they may not be that old, but old they are. They are nevertheless setting out to create Comnet: but then their legislators have proper offices to enable them to access services. And what a range of services they are to be offered, as Table 1 opposite shows.

There is almost a club of Parliamentary computerising officers, who meet at least annually and compare notes on how they are progressing or not as the case may be. What they are all said to be watching, I am told, is the case of Australia.

They are building a new Parliament building in Canberra, a building scheduled to be open in 1988, the bicentennial of the founding of Australia. The last Speaker of the Australian Parliament, Billy Sneddon, was determined that it should be as twentieth-century as could be possible.

British consultants Logica were called in and reported, and the system started to grind on its way. A lot of work still has to be done on the design of the facilities, but it has already been agreed that the Parliament will have communications facilities on the Canadian model common to each department. As Australians are generally stropky — it is part of

the national character it seems — they will then be allowed to follow their own computing strategy.

Not, however, all: they have already issued contracts to Honeywell to provide a pilot word processing system, which will in the end probably mean that there will not be a compatibility problem among MPs when it comes to intercommunication by the electronic word. Honeywell, too, will also print Hansard during the pilot phase.

ICL is creating a pilot database on POLIS lines which will cover both the Houses: Representatives and the Senate.

THE SHAME OF IT

It is going to be some time in either case before one can tell whether or not these systems help MPs to question the executive more closely. However there are MPs, who prefer to be nameless, who believe that the developments in both countries whose Parliaments, after all, sprang from and are in large part modelled on our own, might shame the powers in our Parliament into moving more rapidly.

Personally I have hopes of Australia, and not because of MPs fighting the executive, but because of an unexpected member of it. His name is Barry Jones, and the last expectation he had was to become a Minister. But he is, and what is more he is Minister of Science and Technology.

But in his previous life, he is best known as the Alvin Toffler of Australia. He wrote that country's equivalent of **Future Shock**, and argues strongly in favour of the wide use of computing equipment and skills. You have then the unusual alliance of powerful people on both sides determined to do something.

If, of course, they can extract the funds to do so: the Australian Treasury is as mean as our own, or at least that is what my Australian friends tell me. Meanwhile I am afraid that the executive is likely to continue to get away with it. The attitude of Parliamentarians generally seems to be similar to that of... Well, to paraphrase St Augustine, "Oh Lord, please provide me with the help of computing, but not yet."



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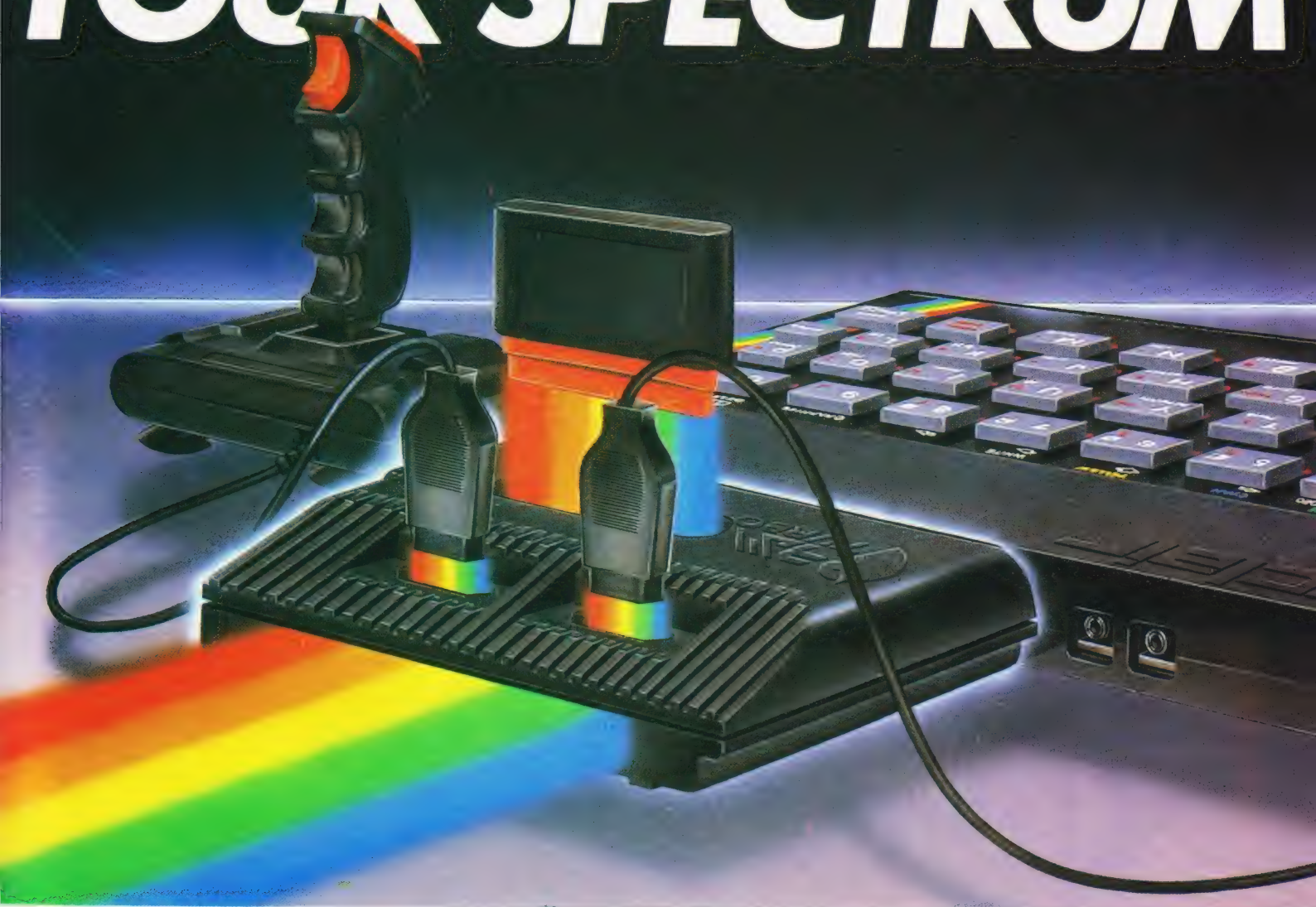
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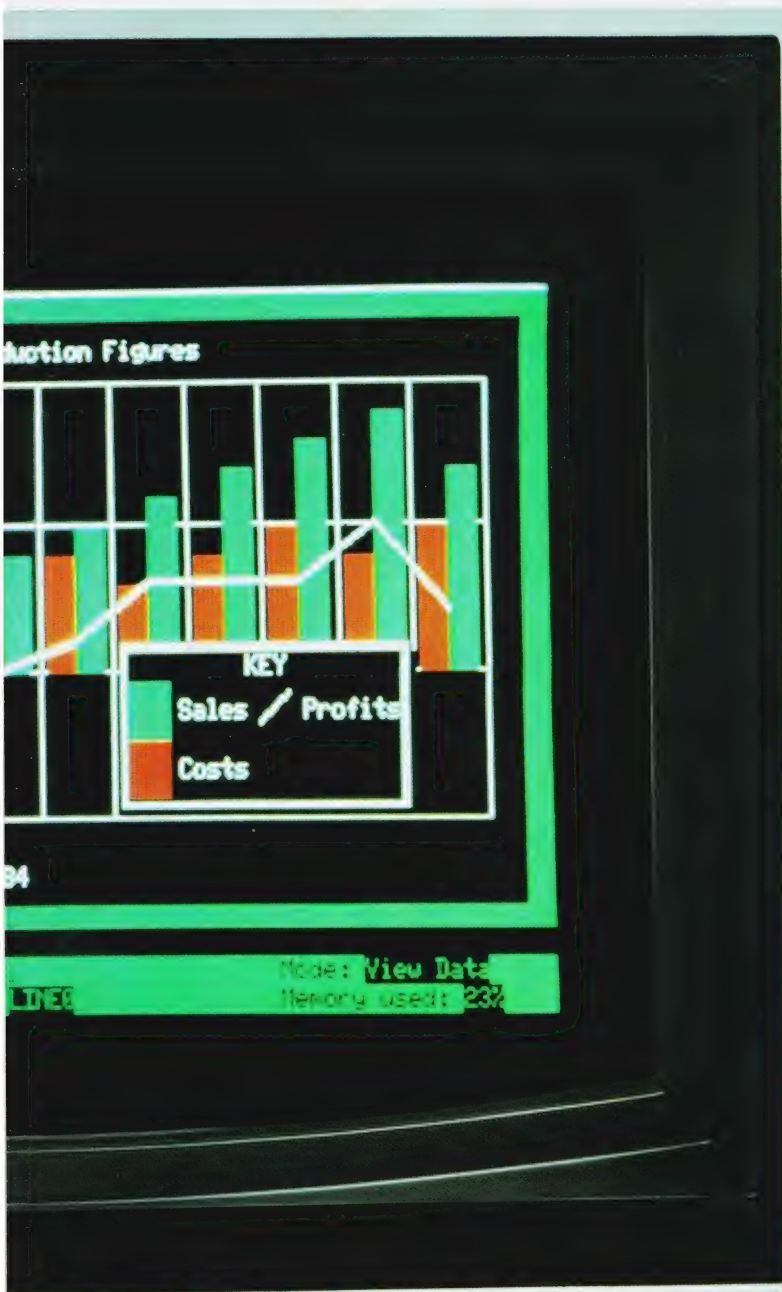
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The Sinclair QL has 128K RAM. Big deal?

Several micros offer 128K RAM, or more, as standard. The 'What Micro?' table for December 1983 lists over 50 of them – but 40 of the 50 micros listed cost over £2,500!

The Sinclair QL offers you 128K RAM for under £400, and an option to expand to 640K. That's a lot of bytes to the pound!

The Sinclair QL has a 32-bit processor. Who else?

Under £2,700, nobody. Even the new generation of business computers, such as the IBM PC, are only now beginning to use 16-bit processors.

At prices like this, the Motorola 68000 family – widely regarded as the most powerful microprocessors available – will remain a luxury.

Yet with the Sinclair QL, the 32-bit Motorola 68008 is available for less than £400.

You can also be sure that the QL will not become outdated. 32-bit architecture is future-proof.

32-bit processor architecture, 128K RAM, and QDOS combine to give the QL the performance of a mini-computer for the price of a micro.

Exclusive: new QDOS operating system

No competition! QDOS sets a new standard in operating systems for the 68000 family of processors, and may well become the industry standard.

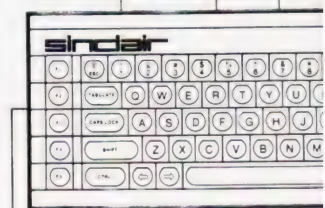
QDOS is a single-user, multi-tasking, time-sliced system using Sinclair's new SuperBASIC as a command language.

One of its most significant features is its very powerful multi-tasking capability – the ability to run several programs individually and simultaneously. It can also display the results simultaneously in different portions of the screen. These are features not normally available on computers costing less than £7,000.

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QL ROM Cartridge slot

2 x Joystick ports 2 x RS-232



Expansion slot

New professional keyboard

The QL keyboard is designed for fast input of data and programs.

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A membrane beneath the keyboard protects the machine from dust (and coffee!), and for users who find an angled keyboard more comfortable, the computer can be raised slightly at the back by small detachable feet.



£399

because there's no comparison!

Advanced new friendly language – Sinclair SuperBASIC

The new Sinclair SuperBASIC combines the familiarity of BASIC with a number of major developments which allow the QL's full power to be exploited.

Unlike conventional BASIC, its procedure facility allows code to be written in clearly-defined blocks; extensibility allows new procedures to be added which will work in exactly the same way as the command procedures built into the ROM; and its constant execution speed means that SuperBASIC does not get slower as programs get larger.

Included – superb professional software

The suite of four programs is written by Psion specially for the QL and incorporates many major developments. All programs use full colour, and data is transportable from one to another. (For example, figures can be transferred from spreadsheet to graphics for an instant visual presentation.)

Word-processing



Certain to set a new standard of excellence, QL Quill uses the power of the QL to show on the screen exactly what you key in, and to print out exactly what you see on the screen.

A beginner can be using QL Quill for word-processing within minutes.

QL Quill brings you all the facilities of a very advanced word-processing package.

Business graphics



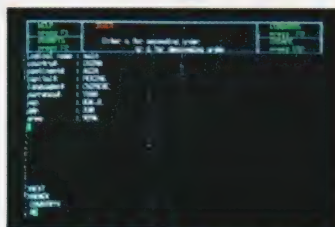
QL Easel is a high-resolution colour program so easy to use you probably won't refer to the manual! It handles anything from lines, shaded curves or histograms to overlapping or stacked bars or pie charts. QL Easel does not require you to format your display before entering data; it handles design and scaling automatically or under your control. Text can be added and altered as simply as data.

Spreadsheet



QL Abacus makes simultaneous calculations and 'what if' model-construction easier than they've ever been. Sample applications are provided, including budget-planning and cash-flow analysis. QL Abacus allows you to refer to rows, columns and cells by names, not just letters and numbers. Function keys can be assigned to change a variable and carry out a complete 'what if' calculation with a single key-stroke.

Database management



QL Archive is a very powerful filing system which sets new standards, using a language even simpler than BASIC. It combines ease of use for simple applications – such as card indices – with huge power as a multi-file data processor.

An easy-to-use labelling facility means that you don't have to ask for your file by its full name – a few letters are enough.

New – the Sinclair QLUB

The QLUB is the QL Users Bureau. Membership is open to all QL owners. For an annual subscription of £35, QLUB members receive one free update to each of the four programs supplied with the QL, and six bi-monthly newsletters. Sinclair has also made exclusive arrangements for QLUB members to obtain software assistance on QL Quill, Abacus, Archive or Easel by writing to Psion.

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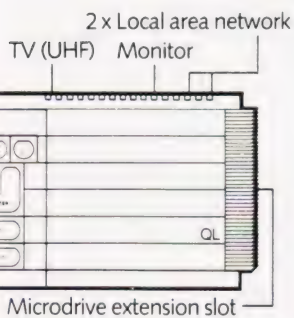
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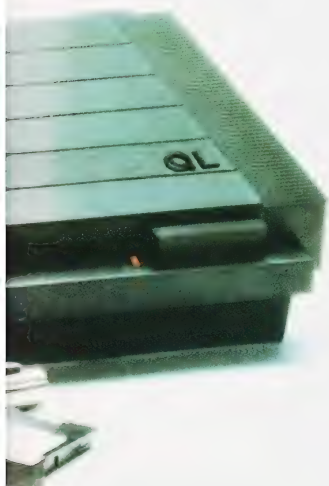
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This month's books are all for the Commodore 64. There are half a dozen of them chosen from the absolute deluge that this computer has encouraged. The topics that they cover range from how to program the 64 and what it can do, to writing adventure games for it and doing mathematics with it.

The Commodore 64 is the cheapest of the currently available computers, with 64K of memory and it also has a reasonably priced disc drive. Since it can support a wide range of business and other substantial applications, there is a good deal of serious software being written for it, as well as all the games. For these, and other, reasons the computer is selling in large quantities. The imminent availability of the executive, and portable, version adds to the general appeal.

Given that the 64 is a powerful and popular computer, it might be expected to have a decent manual, except that as soon as we recall that it is called the *Commodore 64*, this expectation immediately shrivels. But, in a sense, Commodore is a valuable asset to the publishers and authors of computer books, because, more than most computer manufacturers, every one of their computers sets off a new round of 'manual replacement' publishing.

The 64 needs these substitutes for the manuals more than its predecessor, the PET, did. Although it is burdened with the PET's BASIC, the 64 is a much more powerful machine altogether. All those people dying to get at the sound and graphics chips to make them do their stuff not only have to find the addresses of the memory locations concerned but also have to discover exactly what it is that each location controls. The manual seems to think that this should be a big secret, but the books are disposed to reveal all.

It has to be said that none of the books examined here does for the 64 what **The PET Revealed** or Donahue and Enger's **PET Personal Computer Guide** did for the PET. Since the 64 is altogether more sophisticated than the PET, this is not surprising but, at the same time, it means that the need for it is more urgent. There are so many things of which the 64 is

capable that the unsuspecting owner of one may not realise. Quite unknowingly, the solutions to all his problems may be within the computer's range.

To illustrate this, the computer has a genuine 64K of RAM, with all the ROMs shadowed by RAM, which is ready to be brought into action when a ROM is switched out. Also, the keyboard is 'soft', so that you can design and use your own letter font should you be so minded, or invent graphics characters to associate with every key so that you can type out pictures with the greatest of ease rather than paragraphs of text. But these facilities, and the ways to release them have to be dug out

nugget by nugget.

I have had a Commodore 64 at home for the last couple of months, and this has enabled me to test the books against the machine, and I can report that most of the programs that I have tried from the books actually work. (I wouldn't want to give the impression that I have typed in every program in every book, though!) But, more important than this, I have found that you can come to grips quite quickly with the graphics and sound once the necessary information is provided. I don't think that you need something like Simons' BASIC for this, although it is undoubtedly a considerable convenience. Programs written

BOOK PAGE

Garry Marshall

Commodore won't write any decent literature about their machines, which makes it open season for everyone else. Here's a selection of the books on offer concerning the Commodore 64.



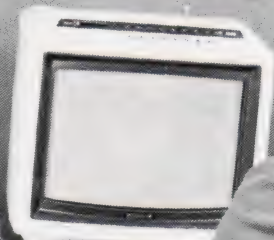
in the 64's own BASIC for generating graphics, sprites and sounds are just masses of PEEKs and POKEs, but there are certain patterns to the numbers that you have to remember. The bad news is that in obtaining this information, I found a bit in one book and a bit in another, but very rarely a complete presentation and explanation in any one.

As to the books themselves, **Commodore 64 User's Handbook** from Weber Systems Inc is the nearest to what a manual should be, and the least pretentious — it makes no bones at all about being written as a manual. It is a bit dry and dull, but then any manual would be, wouldn't it? It is a good source of reference, but is inclined to stop short just as you get to the stage of delving deeply into something. When dealing with sound generation, for example, it resorts to presenting programs (full of POKEs, of course), but the significance of some of the locations being POKEd is not explained. This can be very frustrating, since my ears cannot distinguish between the sounds of triangular and ramp waveforms when they have been filtered so as to pass only certain frequency components from the original signal. But the only way to deduce what is going on in the program is to listen to the sounds it produces. However, this book gives a good treatment of everything the computer can do up to and including the foothills of its more sophisticated features.

The Sensible 64 — Programming With The Commodore 64 by David Highmore and Liz Page is full of valuable information, program segments and, indeed, programs. As a book it is a very amateur affair. The authors do not seem to know that one paragraph should lead into the next, that chapters should have chapter headings, and that a book

THE SENSIBLE 64

Programming with the Commodore 64
David Highmore & Liz Page



Commodore 64 getting the most from it

TIM ONOSKO

EXPLORING ADVENTURES on the Commodore 64

mathematics on the commodore 64

essential routines for programming

czes kosniowski



ould have an index. It is much
re reminiscent of a rather
r student's report on a
ect than of a book in its pre-
tation. However, if we take it
a collection of bits and
ces, some of the bits are very
ful. There is illuminating
ormation on sprites, bit map-
g for high-resolution graph-
and on producing music. But
book's poor layout and lack
an index make it inadequate
a source of reference. I found

it a useful complement to other
books, but if you want to buy just
one book for the 64, I couldn't
recommend this as the one.

**Commodore 64 — Get-
ting The Most From It** by Tim
Onosko really is a proper book.
It is well designed, well printed,
and as readable as this kind of
book can ever be, written in a
light, racy style. It covers much
the same ground as the pre-
vious two books, although
again not giving a complete

coverage. The body of the book
gives a relatively low-level
coverage of the main features,
but the appendices give treat-
ments at a much higher level of
the inner workings of the 64 (by
Jim Butterfield), graphics and
sound. For my money, this is
much the best of the three
books. But none gives a com-
plete coverage and, in fact,
there are still gaps to be found
when you take all three to-
gether.

For those who know how to
program their 64 and have a
good idea of its capabilities, the
other three books we are
examining may help to provide
programming ideas. **Explor-
ing Adventures On The
Commodore 64** by Peter Ger-
rard is about creating and writ-
ing adventure games. It is good
on explaining how to devise a
game and then develop the
program for it. It strikes me that
following the ideas in the book

would be an instructive, and also enjoyable, way to learn how to design and write long programs of any kind.

The book is not a collection of adventure game listings, for it is much more valuable than that could be. It contains routines for particular purposes that can be put together to make programs. It also presents the ideas for putting them together. The routines incorporate programming techniques drawn from many application areas which can, similarly, be borrowed again for other purposes. Very good, and not just for adventure game enthusiasts.

Mathematics On The Commodore 64 by Czes Kosniowski is just what its title sug-

gests. It has chapters on topics such as trigonometry, number bases and matrices. Each chapter explains fairly briefly the mathematics of its topic and then presents a program to make the computer do the mathematics concerned. This might be a useful aid to the study of 'O'-level and 'A'-level maths. It also contains chapters on codes and prime numbers so, if the recent publicity over Arnold Arnold, Fermat's last Theorem and national security has captured your attention, this could be the place to follow up that interest.

Finally, **Sixty Programs For The Commodore 64** from Pan/PCN computer library is a mundane collection of program listings, mainly of some familiar and pretty tired games.



This month's books were:

Commodore 64 User's Handbook by WSI staff, Weber Systems Inc, 307 pages, \$14.95

The Sensible 64 — Programming The Commodore 64 by David Highmore and Liz Page, Micro Books, 117 pages, £5.95

Commodore 64 — Getting The Most From It by Tim Onosko, Prentice-Hall International, 303 pages, £7.95

Exploring Adventures On The Commodore 64 by Peter Gerrard, Duckworth, 242 pages, £6.95

Mathematics On The Commodore 64 by Czes Kosniowski, Sunshine Books, 155 pages, £5.95

Sixty Programs For The Commodore 64 by R. Erskine and H. Walwyn, Pan/PCN computer library, 380 pages, £5.95

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GOING APE-FACE

Martin Edwardes

If connecting a Centronics printer to your Atari computer has been gibbon you problems, the Apeface provides a simple solution with no monkeying around.



One major problem with the Atari, an otherwise excellent machine, is the lack of standard ports to add extra peripherals on to the system. The only thing it has is the peculiar plughole at the side through which all the information passes for all the peripherals. There are also the joystick ports, but using these with any device more complex than a light pen becomes very difficult. It wouldn't be so bad if the side port looked like anything else on this planet. But, unfortunately, it is like the sound and graphics capabilities of the Atari: out of this world.

Many Ataris in this country have been bought by people

who are upgrading from another machine, and this appears to be true for the 600XL and 800XL as well. As a result many owners have an Atari, a standard Centronics parallel interface printer, and no way of allowing them to talk to each other. This is where Apeface steps, or plugs, in.

It consists of a black box with two wires coming out of each end. At one end a round cable ends in a 'standard' Atari plug, at the other a ribbon cable ends in a standard Centronics printer interface. You just plug in each end and that's it! The output signal from the Atari is a serial data stream (the eight bits that



define a character follow one after the other) while the input signal to the Centronics is parallel (the eight bits go down eight wires simultaneously). The Apeface does the necessary conversion and leaves you free to worry about what you are printing rather than how you are printing it. The device is a 'hard' device, so there is no additional software to load, and no extra memory is used up.

APES 'N EPSON

We tried the Apeface on the Epson FX80 printer, which is a good representative industry-standard printer, and we found no serious problems with its use. One noticeable advantage that it has over Atari's own 822 printer is in inverse characters: on the 822 inverse text looks just like ordinary text; on the FX80 it comes out as italics! Of course, the special characters in the Atari character set are not printable, but this is true for any computer attached to an industry-standard printer.

The one problem we encountered with the Apeface is the fact that it is an 'end of line' device. The Atari system works by each device being daisy-chained to the computer. Any signals output by the computer are device-coded, so they pass from one device to another until they

find the device they are coded for. This means that every device in the daisy-chain, other than the computer at one end and one other device at the other end, must have two connectors, one for the input signal and one to pass the signal onto the next device if needed. The Atari 410 tape recorder was defined as the end-of-line device in the original system, so to use the Apeface with this device you must unplug one device and plug in the other. You also have to press System Reset so that the Atari can recognise the new configuration. It is a small problem, and does not occur with the new 1010 tape deck, which has two ports.

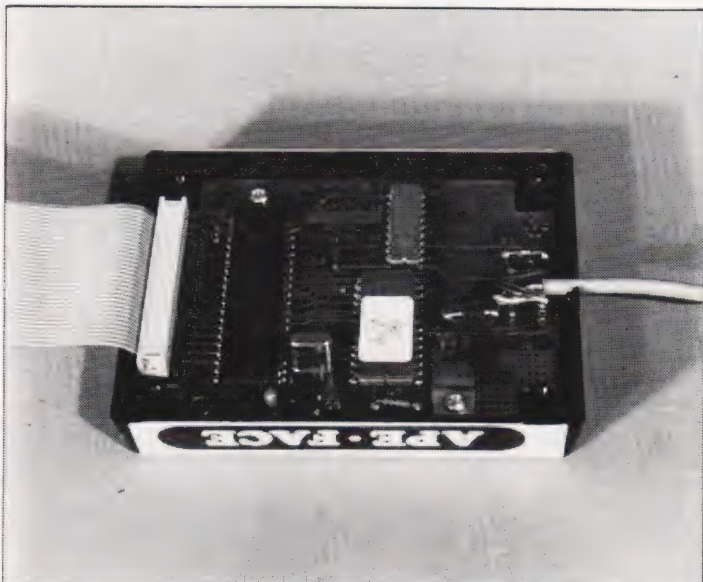
CONCLUSIONS

The Apeface provides a simple and effective solution to the problem of attaching your non-standard Atari to a standard printer. For anyone who already has a printer and wants a good interface, or for anyone who wants to get a non-Atari printer but is unsure of interfacing, I can fully recommend this device.

The Apeface Atari printer interface costs £105 including VAT and postage and packing from Westwood Distribution Ltd, 116/118 Tennant Street, Five Ways, Birmingham, B15 1EY.

Bottom left: The Atari Peripheral Expander Interface (Apeface — geddit?) is simple to use. It comes with a cable at each end, one for the computer and one for the Centronics printer. And that's all!

Bottom right: Inside the Apeface construction is neat and compact. The large chip on the left is actually a microprocessor, one of the Z8 range from Zilog, which explains why no additional software needs to be loaded into your computer. Effectively you're buying a second small computer dedicated to just one job.



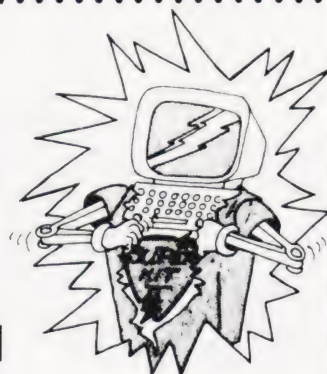
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When a large amount of text is stored in a microcomputer it is generally the case that the user is left wishing for more memory within his machine, and a speedy means of storing and retrieving that information. The popular and affordable micros are not particularly suited to text orientated applications — their bit-mapped screens are ideal for graphics and game playing, but together with their large monitor ROMs, they take a generous slice from the 64K memory map, leaving less for the user. Add to this the fact that cheap disc storage systems are not quite with us (notwithstanding the efforts of Sir Clive), and the case for compacting text as tightly as possible into RAM becomes increasingly attractive, and worth the overhead of the encoding and decoding software.

The micro is extremely efficient when handling large amounts of text, and in the business world this is perhaps the most common application of all (not to mention many Adventure games); but the data really needs to be in internal RAM, and it is here that the user of a small, cassette-based system runs into problems. To be specific, how do you get a library catalogue of 2000 titles into a 48K Spectrum? The key to the problem of compaction lies in the nature of the ASCII code itself.

THE ASCII CODE

The ASCII code occupies a single byte of memory, and allows for 256 characters to be represented. It is the coding system used by most micros today, and although it professes a set standard (American Standard Code for Information Interchange) this only applies to 96 characters. These are the letters of the alphabet, the numerals, punctuation symbols, and a few extras such as dollar and percentage — in short, the characters and symbols required for textual work.

BIT MANIPULATION

One solution to packing text more densely is to reduce the character set used to 64. Since 64 different symbols can be represented by six bits in binary, then it follows that three bytes of memory can be made to hold four symbols (see Fig. 1). This will compact any data base

1111112222333333444444

Fig. 1 Storing four characters in three bytes.

down to 75% of its original size, but it causes a few problems, not so much in the unscrambling of the bits from the bytes, but in deciding how many screen and printer control codes will need to be altered. Their normal codes range from 0 to 31, but their new values must lie somewhere in the six-bit range from 32 to 127 and when that new value is adopted, an existing symbol will have to be sacrificed.

Greater compaction is possible using this bit-shuffling system. A five-bit ASCII code would consist of 32 symbols, allowing just the upper case alphabet and a few punctuation symbols and control codes. However, although eight symbols would pack into five bytes, representing compaction to 62.5% of the original, the restricted size of the character set is likely to be unacceptable. Other compaction methods might produce better results.

TABLES AND TOKENS

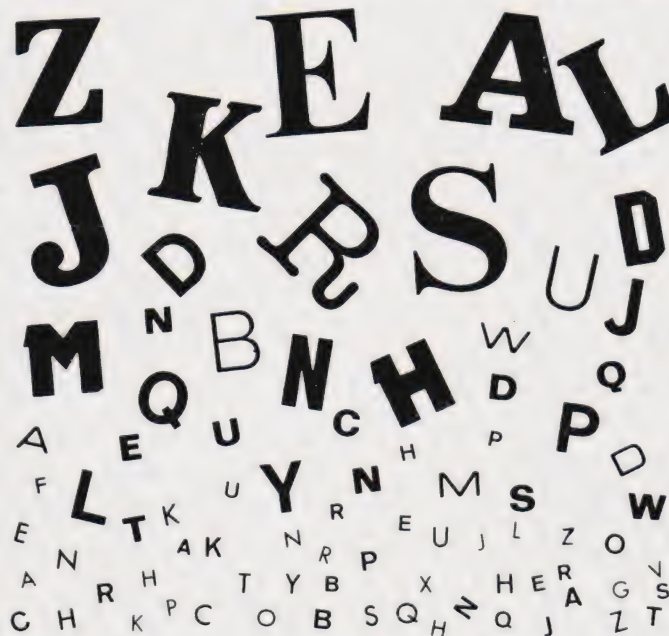
Leaving the standard ASCII set severely alone, there are still

128 symbols available with codes from 128 to 255. These are not used by some computers, while in others they cause a whole range of exotic graphic symbols to be displayed on the screen. When a high-level language is being used, codes in this range are made to represent complete words. Thus in Sinclair BASIC the single byte F9 hex stands in for the word RANDOMIZE, and that's compaction to 11% of the original! The complete word is known as the reserved word and the byte representing it is known as the token. A dictionary of all the reserved words used is contained in a look-up

Z80 TEXT COMPACTOR

Richard Sargent

How do you get a quarter of a megabyte into a pint pot? Here are encoding and decoding machine-code routines which should prove suitable for any Z80-based micro.



ONE	OUT	PAT	IGHT	STAR
WAR	AND	ASS	THE	OF
SHO	TER	ING	BAR	COM
INS	KEN	MAD	ATE	EAR
DRA	DRI	NOW	DAY	DOG
FOR	ARY	PAR	BEA	BEL
BLE	MIS	TAN	TA	IS
AS	AR	CE	DA	AN
OR	BU	NO	FO	ST
ER	AL	TN	IT	LE
CH	BR	ON	ES	BO
WH	TR	BL	EX	VI
SH	SP	FR	ED	EN
TO	TI	TY		

Fig. 2 Useful short strings for any dictionary.

table and this is used in the encoding and decoding process.

BUILDING THE DICTIONARY

In the case of the text compaction program it is necessary to construct your own dictionary and this is done by two tried and trusted methods — common sense and trial and error. Frequently-occurring words are sought out, with priority given to the longer words, since their reduction to tokens will help achieve a good overall compaction. Short groupings of letters are also considered — they are worth encoding if they occur frequently. Figure 2 shows some of the short strings that I found useful. The choice of the longer words will rather depend on the application of the program: if a file of computer magazine articles is being compiled, then words like *microprocessor*, *program* and *joystick* will certainly go into the dictionary.

It is essential to encode the long reserved words first. For example, if all occurrences of the string *micro* are encoded first, the word *microprocessor*



Listing 1. The text compaction routines. Note that OUTBYTE in the DECODE section needs to be tailored for your own operating system.

HOW THE PROGRAM WORKS

Many text encoders and decoders have been written in BASIC but they are naturally rather slow. Typically, the process of encoding is achieved when text is typed in and decoding is done at print time. Since typing and printing are themselves slow processes, the

The program is presented as a Z80 source listing, and is suitable for any microcomputer with a Z80 CPU. There are just the two routines, ENCODE and DECODE, and these together are about 256 bytes long. The reserved word table should be constructed by the user. It can be as long or as short as you wish provided each word in the dictionary has bit 7 of its last character set, and that the list of words is terminated with a unique character (such as an asterisk) also with bit 7 set.

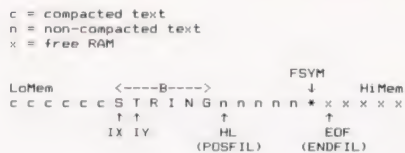


Fig. 3 State-of-play in the memory just before the block-move in the encode routine.

There is a counter within the program and it counts the number of occurrences of a reserved word within a piece of text and displays or prints out the results. It is useful if you need to determine whether to use, for example, *mis* or *miss* in your dictionary. You would use your own monitor or a direct command from BASIC to examine the counter contents (Label: COUNT).

ENCODE

Encode is a subroutine and you may use it more or less as you like, providing certain key values are correctly set before hand. Part or all of the non-compacted file (NCF) must be placed in RAM(NCF-RAM) and on each CALL to the encoding subroutine the entire portion of the NCF is reduced to a small, compacted file occupying perhaps the first half of what was the NCF-RAM. A pointer indicates the new location into which subsequent NCF portions may be loaded and in this manner a large NCF may be read into memory and compacted down. The routine is extremely fast, and will encode a 16K file in about one minute.

In the source listing DS stands for Define Space, DB stands for Define Byte and DW stands for Define Word. The origin has been set at 7D00 hex (32000 decimal) so that it can be loaded into most memory maps, but it will be a simple matter to relocate it at a different address. It can then be used by a controlling program which can be either machine code or BASIC. Since this method of compaction never interferes with screen and printer control codes, it is easy to experiment with the program and to list, for example, a compacted file without first decoding it. As you read through the comments on the source listing it is worth looking at Fig. 3 which shows the state of various registers and pointers prior to the block-move which occurs shortly after label A8.

DECODE

The decode routine is very simple, and very fast. Assuming that a routine already exists to extract a byte from the main file, this little subroutine examines the byte (it is assumed to be in the A register), and expands it if necessary. The expanded word is passed through OUT-BYTE and the code at OUT-BYTE should be capable of printing the contents of the A register to the screen and/or the printer. The code is RST 30H for a Nascom, RST 10H for the Spectrum.

PROBLEMS WITH NUMBERS

It is not possible to tokenise numbers and this leaves us with a problem if the file we wish to compact contains rather a lot of them. Stock numbers, telephone numbers, serial numbers — there could be a few thousand bytes tied up in this way. A method of dealing with them immediately comes to mind, since we know that in its binary form a number will generally take up less space than it does in its decimal/ASCII form. If there are sufficient large numbers (value 1000 and over) in the text, it is probably worth doing providing there are only a few single digit numbers. It's rather a case of all or nothing: if a number like 64000 become compacted into two bytes (binary) that represents a good saving on memory space, but at the same time single digit numbers will be expanded into two bytes. Extra software would need to be written to allow one and two digit numbers to skip the encoding process.

There is a further problem which would present itself at decoding time. With binary numbers present in the compacted file natural boundary markers would be obliterated: the decoding software would need to distinguish between "fullstop, carriage return" (2E,0D) and the number 11789 (2E,0D) — in fact the binary

```

7027                ;*****
7027                ;NUMBER ENCODING AND
7027                ;DECODING ROUTINES
7027                ;*****
7027
705B                                ORG 7E5BH
705B                                LOAD 7E5BH
705B
705B                                ;ENCODE
705B                                ;*****
705B
705B                ;Upon entry HL should point
705B                ;to the first (ASCII) character
705B                ;of the decimal number
705B                ;The decimal number should be
705B                ;terminated with a byte in the
705B                ;range 0-2FH
705B
705B                ;Upon exit DE = BC = binary
705B                ;value The carry is set
705B                ;if the number is invalid
705B                ;HL points to byte after the
705B                ;decimal number
705B
705B 010000    NENCODE    LD BC,0
705E 7E      DH1        LD A,(HL)
705F D630    SUB 30H
7061 D8      RET C
7062 FE0A    CP 10
7064 3807    JR C,DH2
7066 D611    SUB 11H
7068 D8      RET C
7069 FE0F    CP 6
706A 3F      CCF
706C D8      RET C
706D EB      DH2       EX DE,HL
706E 6F      LD L,A
706F 2600    LD H,0
7071 09      ADD HL,BC
7072 D8      RET C
7073 13      INC DE
7074 1A      LD A,(DE)
7075 FE30    CP 30H
7077 3B09    JR C,DH4
7079 44      LD B,H
707A 4D      LD C,L
707B 3E09    LD A,9
707D 09      ADD HL,BC
707E D8      RET C
707F 3D      DEC A
7080 20FB    JR NZ,DH3
7082 44      DH4       LD B,H
7083 4D      LD C,L
7084 EB      EX DE,HL
7085 1B07    JR DH1
7085
7085                                ;DECODE
7085                                ;*****
7085
7085                ;Upon entering this routine
7085                ;HL holds the binary value
7085
7085                ;Upon exit the decimal value
7085                ;(as ASCII characters) is
7085                ;held in RAM5 to RAM1 with
7085                ;the least significant digit
7085                ;in RAM1 Binary in HL
7085
7087 E5      NDECODE    PUSH HL
7088 D5      PUSH DE
7089 C5      PUSH BC
708A DDE5    PUSH IX
708C 11CA7E  LD DE,RAM5
708F DD21C07E LD IX,DATA
7093 3E2F    HD1       LD A,2FH
7095 DD4E00  LD C,(IX+0)
7096 DD4601  LD B,(IX+1)
709B C601    HD2       AD A,1
709D ED42    SBC HL,BC
709F 30FA    JR NC,HD2
70A1 09      ADD HL,BC
70A2 12      LD (DE),A
70A3 DD23    INC IX
70A5 DD23    INC IX
70A7 13      INC DE
70A8 0D      DEC C
70A9 20E8    JR NZ,HD1
70AB 0605    LD B,5
70AD 21C97E LD HL,RAM5-1
70B0 23      HD3       INC HL
70B1 7E      LD A,(HL) ;Output
70B2 F7      RST 30H ;five
70B3 0000    DB 0,0 ;ASCII
70B5 0000000 DB 0,0,0 ;digits
70B6 10F6    DJNZ HD3
70B8 DDE1    POP IX
70BC C1      POP BC
70BD D1      POP DE
70BE E1      POP HL
70BF C9      RET
70BF
70C0 1027    DATA    DW 10000
70C2 EB03    DW 1000
70C4 6400    DW 100
70C6 0A00    DW 10
70C8 0100    DW 1
70C8
70CA        RAM5      DS 1
70CB        RAM4      DS 1
70CC        RAM5      DS 1
70CD        RAM2      DS 1
70CE        RAM1      DS 1
70CE

```

Listing 2. Two subroutines for encoding and decoding numbers.

byte could be mistaken for anything including printer control codes and the tokens themselves. In short, number compaction of this type can only be attempted within files which have a tight structure or fields and where the software can tell

the difference between a carriage return and the number 13. The starting point of such software will be the basic number encoding and decoding routines, and these are provided as two short subroutines.

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24-way	36	60
26-way	40	65
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CASSETTE 300 or 1200 baud
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KEYBOARD QWERTY CURSOR NUMERIC FUNCTION
DISPLAY TV MONITOR SUPPLIED
INTERFACE PARA SERIAL BUS
GRAPHICS BLOCK USER RES 392 by 256
 COLOUR 8 TEXT 80 by 25

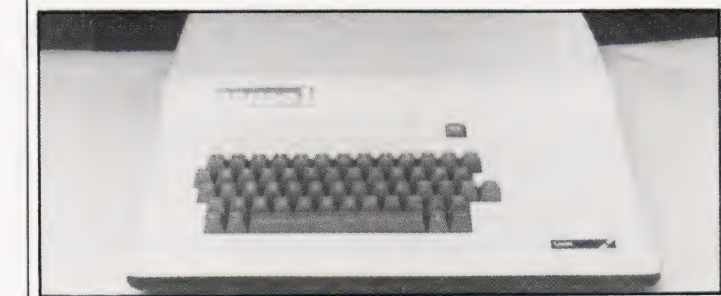
Notes. The Lucas LX is a Z80A microcomputer aimed more at the professional and business user. Hence 5Mb Winchester disc interfacing is provided. Popular printers may be used with the RS232C serial interface, and a Centronics interface is also provided. There is an additional parallel interface connector for providing up to 16 on/off signals. The monitor supplied as standard is a 12" monochrome version: a colour monitor is also available. The high res colour graphics may be 392 by 256 in eight colours, or 784 by 256 in two colours. A wide range of applications software is available via the CP/M operating system, including Wordstar, Supercalc, and Calcstar.



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LANGUAGE Microsoft BASIC
CASSETTE 300 or 1200 baud
 extra DOS CP/M or NAS-DOS
KEYBOARD QWERTY CURSOR NUMERIC FUNCTION
DISPLAY TV MONITOR SUPPLIED
INTERFACE PARA SERIAL BUS
GRAPHICS BLOCK USER RES 784 by 256 (two colours)
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 COLOUR 8 TEXT 25 by 80
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LANGUAGE Commodore BASIC
CASSETTE 300 baud
DISC Twin in-built floppy drives
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DISPLAY TV ☐ MONITOR SUPPLIED ☒
INTERFACE PARA ☒ SERIAL ☒ BUS ☐
GRAPHICS BLOCK ☒ USER ☐
LINE ☐ RES 80 by 25
COLOUR 16 TEXT 80 by 25

SOUND

Three channels

Notes. The Commodore 720 is the top model in the 700 range of business machines. It is built round the 6509 processor, but there is a dual processor (Z80 or 8088) option. The machine has been designed to meet the IEC specifications. The black-and-white monitor screen is integral and features tilt and swivel. The keyboard may be detached. The dual disc drives are built-in to the main housing and use DMA transfer, increasing speed.



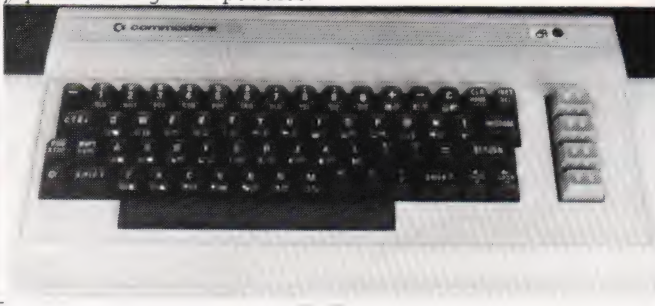
COMMODORE 64

MEMORY 64K RAM 26K ROM
LANGUAGE PET BASIC
CASSETTE 300 baud
DISC extra DOS
KEYBOARD QWERTY ☒ CURSOR ☒ NUMERIC ☐ FUNCT ☒
DISPLAY TV ☒ MONITOR SUPPLIED ☐
INTERFACE PARA ☒ SERIAL ☒ BUS ☒
GRAPHICS BLOCK ☒ USER ☒
LINE ☐ RES 80 by 25
COLOUR 16 TEXT 40 by 25

SOUND

Three channels

Notes. The Commodore 64 is a 6510 based micro that can also use Pascal, COMAL, LOGO, FORTH and PILOT. Programs can be loaded from cassette recorder or disc drives, both extra, or cartridges. The various peripherals include printer, joysticks and games paddles.



SHARP MZ-80A

MEMORY	48K RAM	4K ROM
LANGUAGE	Microsoft BASIC	
CASSETTE	1200 baud (built-in)	
DISC	extra	DOS
KEYBOARD	QWERTY <input checked="" type="checkbox"/>	CURSOR <input checked="" type="checkbox"/> NUMERIC <input checked="" type="checkbox"/> FUNC <input type="checkbox"/>
DISPLAY	TV <input type="checkbox"/>	MONITOR <input checked="" type="checkbox"/> SUPPLIED <input checked="" type="checkbox"/>
INTERFACE	PARA <input checked="" type="checkbox"/>	SERIAL <input type="checkbox"/> BUS <input checked="" type="checkbox"/>
GRAPHICS	BLOCK <input checked="" type="checkbox"/>	USER <input type="checkbox"/>
	LINE <input type="checkbox"/>	RES 80 by 50
	COLOUR	TEXT 25 by 40
SOUND	Single channel	

Notes: The Sharp MZ-80A is a Z80 based micro. An expansion unit, printer, floppy disc unit and other peripherals are available. Other languages can also be used such as Pascal merely by replacing the tape. With the floppy disc option the machine can respond to higher level software such as Disc BASIC and FDOS (including BASIC compiler). A small range of business and educational software is available. The supplier is **Sharp Electronics (UK) Ltd.** Thorp Road, Newton Heath, Manchester M10 9BE.



SHARP MZ-80B

MEMORY	64K RAM	2K ROM
LANGUAGE	BASIC (on tape)	
CASSETTE	1800 baud	
DISC	built-in	DOS
KEYBOARD	extra	QWERTY <input checked="" type="checkbox"/> CURSOR <input checked="" type="checkbox"/> NUMERIC <input checked="" type="checkbox"/> FUNC <input type="checkbox"/>
DISPLAY	TV <input type="checkbox"/>	MONITOR <input checked="" type="checkbox"/> SUPPLIED <input checked="" type="checkbox"/>
INTERFACE	PARA <input type="checkbox"/>	SERIAL <input type="checkbox"/> BUS <input checked="" type="checkbox"/>
GRAPHICS	BLOCK <input checked="" type="checkbox"/>	USER <input type="checkbox"/>
	LINE <input checked="" type="checkbox"/>	RES 320 by 200
	COLOUR	TEXT 25 by 80
SOUND	3 channels	

Notes: The Sharp MZ-80B is a Z80A based micro. Various other languages can be loaded as the machine is "soft", no language being fitted in ROM. Expansion unit, the MZ-80P5 printer and the MZ-80FB floppy disc drive are also available. The supplier is **Sharp Electronics (UK) Ltd.** Thorp Road, Newton Heath, Manchester.



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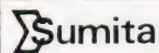
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WORD-WRAPPING

Peter Green

Formatting text output on a micro can be a very tedious business if you are relying on the PRINT statement alone. This routine for the Electron and OS 1.2 BBC machines will prevent words from breaking.



If any of you have used a word processor, either on your own system or in your office, you will know that one of the nice features is that, unlike a typewriter, you aren't required to hit the carriage return key at the end of every line. You can just continue typing words and the software itself worries about the line ends, automatically shifting a word onto the start of the following line if it would otherwise be broken across the right margin. Really sophisticated software, such as that used in our typesetting machines, will know all the legitimate places that a word can be hyphenated to improve the spacing on short lines, but we aren't going to get that ambitious.

On a microcomputer (that isn't running a word-processing package, of course) such luxury is unknown. The PRINT command is very clever in some ways: it knows where on the screen to put the next character, how to set the necessary bits in screen memory to display the correct character if the screen is bit-mapped like the BBC/Electron; how and when to scroll the screen. What it doesn't know is how to prevent words being broken in half, which is evident whenever you list a program with long lines or

write a program that has to deal with lots of text output. Imagine the fun that the editors of our tape-based magazines have in trying to get every screenful reading sensibly!

The procedure presented in this article was originally written to enable a number of strings to be output consecutively to the screen of the Electron in a text adventure being converted for ASP Software. I wanted to run the location description, list of possible exits and visible objects together into one block of text for neatness, but since each of the strings could be of indeterminate length (you might or might not have picked up some objects or found secret exits) it would have meant that words would certainly be broken indiscriminately, resulting in an unacceptable display.

This routine solves the problem by outputting strings as normal until it detects a broken word, then 'backing up' the string, erasing the screen

characters as it does so, until it finds a space, whereupon it continues printing as normal from the start of the next line. It will work on the Electron and on BBC Micros fitted with the OS 1.2 operating system.

OBJECTIVES

When developing this routine I wanted to keep it as general-purpose as possible, so that it would be a useful tool in other BBC BASIC programs and also so that it would make a decent article for the magazine! This meant that the routine should be able to handle any string literal or string variable that you might use, so it was necessary to pass the string to be printed as a parameter. I also wanted the routine to be able to deal automatically with any window that might have been set up by the program, and to be independent of mode. This meant looking at the page 3 location that the operating system uses to store the right margin. Finally, the program had to conform to one of my personal foibles — I don't like printing on the first and last columns, ie I like one one-column margins around my text. This is because most of my work in the Electron uses a coloured background, and there is no facility in the BBC operating system to change the border colour, as you can on virtually every other colour computer on the market (Acorn take note!). Printing looks very cramped if it goes right up to this black border, hence the margins. As it turns out, this makes the wrapping algorithm very easy to implement.

The first version I wrote was in pure BASIC — nobody writes in machine code unless they really have to! I had to. The BASIC version worked fine, but was unacceptably slow on even a few lines of text compared to the speed of the unadulterated PRINT command. The machine code version is not noticeably slower than the standard PRINT.

HOW IT WORKS

The three possibilities that can occur at the end of the line when trying to print a string are shown in Fig. 1. At the end of the first line, the space between words has coincidentally fallen on the last column of the current window. In this case the routine has to do nothing: the next character will be printed automatically at the first position in the next row by the operating system, thus leaving the required minimum margin of one space on the right and starting the next word against the left margin. (This assumes that there is one and only one space between each word in your string. A lot of people don't seem to realise it, but in English there should also be a space after every piece of punctuation. If you start a new word right after a comma, full-stop or so on, the program will treat the first and second words, plus the punctuation, as one word and wrap the whole thing. It is the programmer's responsibility to make sure there are spaces in the correct positions in all the strings to be printed.)

In the second case the last character of a word has fallen

A	T	T	H	E	M	E	E	T	I	N	G		T	O	D	A	Y	.		O	N	T	H	E
O	T	H	E	R		H	A	N	D	,			I		A	M		S	U	R	E		Y	O
	C	A	N		S	E	E		T	H	A	T			B	E	C	O	M	E	S		N	E
S	S	A	R	Y		T	O																	

Fig. 1 The various situations possible when printing to the screen.

on the last column of the window. If printing carried on normally here, you can see that the word wouldn't be broken but we have lost the right margin space and there is a one-space indentation at the start of the next line. For tidiness, though not sense, we need to wrap in this case.

Finally we see the case where a word breaks across the right margin boundary. Here, too, it is obvious that we must carry the whole word over to the next line.

If you consider the possibilities in this way, a very simple algorithm suggests itself. Print the characters of the string one at a time, moving a pointer up the string to keep track of your position, until you come to the last column. If the character to be printed is a space, do nothing; the formatting is automatically correct. If any other character is being printed on the last column, move the pointer back down the string, erasing characters on the screen as you go, until you come to a space. Now print a carriage return and carry on printing the string from the current pointer position.

THE PROGRAM

Turning now to Listing 1, the section of assembly language from lines 1080 to 1480 generates the machine code which will follow the above algorithm. The beginning of the program defines the variables for the assembler to use, and the last few lines are a small demonstration of the way the routine works.

The listing is heavily commented and should be fairly self-explanatory. The labels `oswrch`, `osnewl` and `par` (for parameter block) are straight from the manual: they are the subroutine addresses for 'print a character' and 'print a carriage return', plus the starting location of the parameter block concerning the string we are printing. When the machine code is CALLED using parameter `RS`, the location of the parameter block for the string `RS` is placed in `&601` and `&602` (low byte, high byte). We transfer these to zero-page memory (at 'block') and use indirect addressing to get at the information we really need, which is the starting location in memory for the string `RS`. This is stored at 'string' (once again, low byte, high byte). Finally we get the length of the

```

1080  oswrch=&FFEE
1010  osnewl=&FFE7
1020  par=&600
1030  block=&70
1040  string=&72
1050  length=&74
1060  FORI=0TO3STEP3
1070  P%=&E05
1080  [
1090  GPTT:
1100  LDA par+1      \get parameters
1110  STA block
1120  LDA par+2
1130  STA block+1
1140  LDY #0
1150  LDA (block),Y
1160  STA string
1170  INY
1180  LDA (block),Y
1190  STA string+1
1200  INY
1210  INY
1220  LDA (block),Y
1230  STA length
1240  LDY #0
1250  CPY length
1260  BEQ exit      \is string empty?
1270  LDA (string),Y \yes, so exit
1280  .chckln LDX #30A \get first char
1290  CPX #318      \get right hand text window column
1300  BNE print      \compare to cursor position - are we on last column?
1310  CMP #32
1320  BEQ print      \yes, is char a space?
1330  .wrap LDA #127 \if so, print it
1340  JSR oswrch      \otherwise
1350  DEY             \erase last char
1360  LDA (string),Y \point to last char
1370  CMP #32        \load last char
1380  BNE wrap       \was it a space?
1390  JSR osnewl     \yes, so loop back
1400  INY             \no, so print CR
1410  LDA (string),Y \get next char
1420  .print JSR oswrch \print next char
1430  INY             \point to next char
1440  LDA (string),Y \get next char
1450  CPY length     \end of string?
1460  BNE chckln     \no, so loop back
1470  .exit RTS      \finish
1480  ]
1490  NEXT
1500
1510
1520  MODE=&VDUI9,0,1:0:PRINT
1530  REPEAT
1540  READ R:IF R="END" THEN END
1550  CALL &E05,R
1560  UNTIL FALSE
1570  END
1580  DATA HERE S," A STRING. HERE'S ANOTHER STRING. IN FACT, THERE ARE LOTS OF"
1590  DATA " STRINGS HERE, ALL BROKEN UP IN ORDER TO SHOW THAT"," THE MACHINE CODE"
1600  DATA " WORDS PROPERLY. PETER PIPER PICKED A PEC OF PICKLED"," PEPPERS. IF"
1610  DATA " PETER PIPER PICKED A PEC OF PICKLED PEPPERS, WHERE'S THE PEC?"
1620  DATA " OF PICKLED PEPPERS PETER PIPER?"," PICKED","END

```

Listing 1. The word-wrapping source code, for assembly into a REM statement on line 1 (not listed — see text).

string and store it at 'length' (wouldn't do to zap off through the entire memory of the machine printing everything as we go!)

Next we check for an empty string and exit if we find one. Otherwise the first character to be printed is loaded into the accumulator and the check-line test starting at `.chckln` made. This puts the right hand text window column value, which is stored in `&30A` in OS 1.2, into the X register, which is spare, and compares it to the current text cursor column position stored in `&318`. We skip the next section and print the character if the test fails, looping round for another character. If the test succeeds, we must be on the last column and a space is tested for. If we find one we can print it and carry on as normal, otherwise we have to load the accumulator with 127, the ASCII code for backspace/erase, and print it. This continues until we find a space (which we also erase), at which point we print a carriage return, increment Y so that we are pointing the next printing character (the one after the space we have just detected),

print it, and jump back to `chckln` if we haven't come to the end of the string.

The code is position-independent and may be assembled anywhere in memory that you like. In Listing 1 it is assembled at `&E05`, and in this case you need to insert an extra line that isn't shown in Listing 1. This is a line consisting of a REM followed by exactly 76 characters (A is as good as anything). There must be no space between the line number and the REM, and the line number must be the lowest in the program. The first line in a BASIC program is stored at PAGE (`&E00`) as follows: an `&OD` byte, the line number as a two-byte pair, the pointer to the start of the next line, and the token for the REM. Hence when you assemble the machine code, the bytes are written into memory following the REM and are stored in the first BASIC line because they overwrite the existing 'A' characters that reserved the space.

The reason for using this peculiar method when BBC BASIC allows space to reserved for machine code anyway is that the whole section of the

program that does the assembly can be deleted from memory, leaving the machine code ready to run by calling `&E05`. Thus this BASIC line can have any other program that uses it merged onto it (see the manual for information on how to do this), with no wasted memory for the assembler source code which is only needed once, anyway.

Remember that this method requires the REMed line to be the first in the program so that the absolute start address is always the same. If you are moving PAGE around (disc users on the BBC take note), it might be a better idea to CALL `PAGE+5,RS` to avoid any problems.

Using the routine in a BASIC program can be done simply by having a line:

```
XXXX DEFPROC print(R$):
CALL PAGE+5,RS:ENDPROC
```

You can then concatenate as many strings as you like by calling `PROC print` repeatedly with either string variables or string constants as the parameter. The procedure leaves the text cursor at the next printing position following the last character of the previous string.

This latter point brings us to the first word of warning: all the strings after the first one must begin with a space. For one thing, you need one to separate the current string from the previous one, but more importantly, the printing position for the first character of the next string might lie on the last column. If the first character wasn't a space, the routine would try to point to the previous character, and since there isn't one all sorts of problems could occur. It's easy enough to add a space to the start of any string after the first.

The second word of warning is, make sure that the window width is wider than the longest word you have in your text. Otherwise the program will go into an endless loop as it repeatedly tries to print a word on a line that is too short for it. The routine could, of course, be modified to check for this possibility — this is left as an exercise for the reader!

BBC owners with operating systems prior to 1.2 can use the routine by changing `&30A` in line 1280 to `&329`, and changing `&318` in line 1290 to `&32C`.

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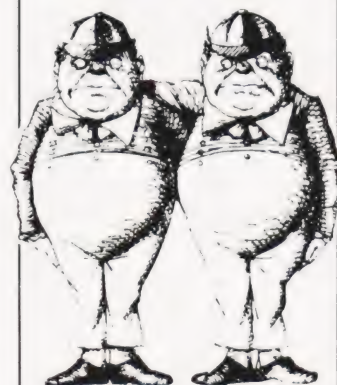
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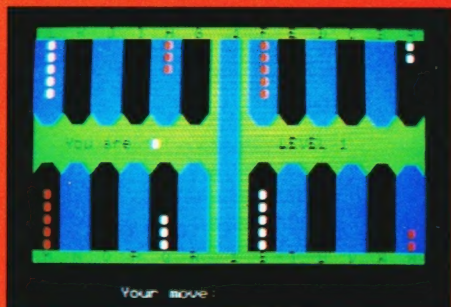
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This most popular of arcade games has been totally recreated for the Sharp computer. Superb graphics and as fast as you like from beginner's level up to 'Superhuman'. Get each of four frogs over the busy motorway, then hop from boat to raft to log to crocodile until safely home sitting on a lily pad. Terrific fun.



BACKGAMMON — £7.95

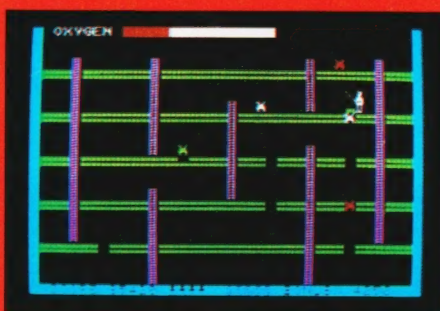
Now available for the MZ-700, this traditional board game can now be played against the computer. Simple to follow instructions for the beginner — higher levels available for the more experienced player.



CHESS — £9.95

Suitable for the rank beginner through to the more experienced player, this Chess program may be used in three different ways.

1. As a referee between two players, checking for valid moves, CHECK and CHECKMATE situations.
 2. As an opponent with 14 levels of intelligence to match your skills.
 3. As a teaching aid when asked to play against itself or show you the best move if you get into difficulties.
- Long games may be saved on cassette for completion at a later time and a print-out of all moves made is available.



SPACE PANIC — £7.95

How long can you survive in the multi-storey building filled with alien bugs. This machine-code programme accurately simulates the arcade game where you climb ladders and dig holes to catch the aliens then fill them in again once they are caught. The red ones must fall through one floor, the green ones, two floors and white ones, three floors. Red aliens who have time to dig themselves out get rather cross and become green. PANIC!! Joy stick or keyboard control.



NIGHTMARE PARK — £6.95

If you have never played this type of game before, you're in for a treat. As you make your way along the intricate pathways to the exit, you are constantly given tasks to perform or games to play. Each of these must be successfully completed before you are allowed to continue. It takes a lot of doing. You must remain quick and alert at all times. A little luck is handy. Amazing graphics and sounds!!!



XANAGRAMS — £9.95

Not only a terrific spelling test but also a great game. You are asked to guess up to five words, represented by blocks on the screen in a crossword format. All the letters that you need are shown on the right of the screen in alphabetical order and the computer will give you the first letter if you ask it nicely. Suits almost any age with 3 skill levels and from 1 to 5 words to be guessed. Really habit-forming!!!



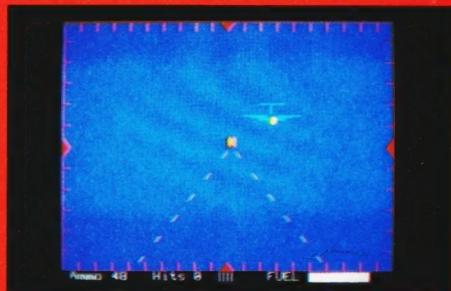
GALAXIANS — £7.95

A high-speed machine-code version of the popular arcade game where the massed space invaders must be cleared from the skies. After a few seconds they will begin to swoop and dive at you, showering you with scatter bombs as they go. The game becomes progressively more demanding as you kill more and more of the marauding aliens. Very entertaining — hours of fun!!! Joy stick or keyboard control.



FIGHTER COMMAND — £6.95

A mission flown completely on instruments where you are pursuing a fleet of ten enemy aircraft fleeing from you. They will show on your long range radar screen and you must manoeuvre your craft to get them within range of your missiles. If you get too near, they will fire at you and warp away to safety. You only have one chance to destroy incoming missiles with your lasers.



LIGHTNING PATROL — £3.95

Choose your rank in the RAF and you are immediately sent on a mission to catch and shoot down ten enemy Mirage jets that are fleeing after their attack on your airbase. You must manoeuvre your plane to get them in your gun-sights whilst they are weaving about the sky to avoid being hit. Limited ammunition and fuel available so efficiency and accuracy are all important to your completion of the mission. Promotion for the successful but poor performances can mean you are asked to leave the air force. Joy stick or keyboard control.

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